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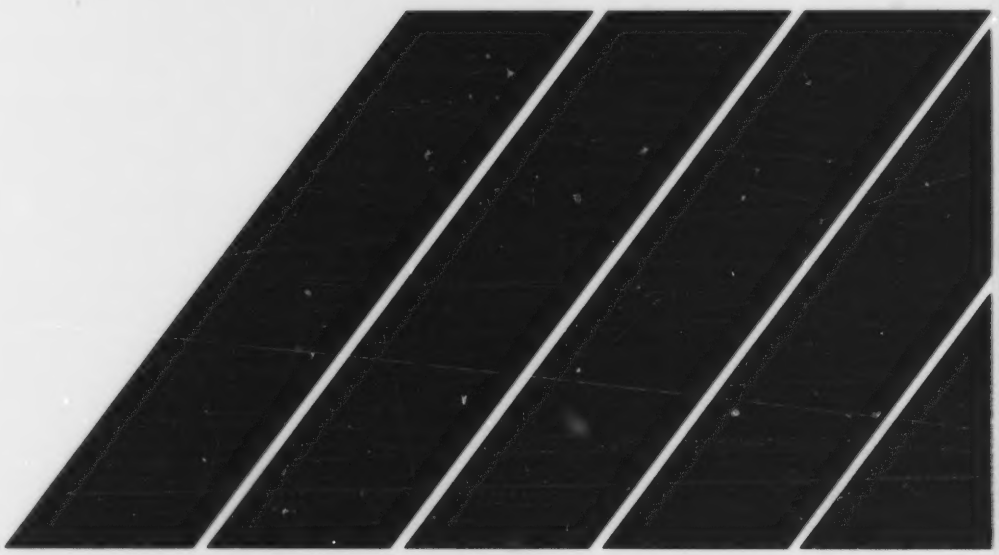
REPORT ON RENEWABLE ENERGY POLICIES IN WESTERN EUROPE



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REPORT ON RENEWABLE ENERGY POLICIES IN WESTERN EUROPE

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Preface

This report reviews the status of renewable energy in overall energy policies and programs in Europe and updates a previous study on this subject undertaken for Energy, Mines and Resources Canada in 1988.

"At present renewables are not an active research area for any of the core faculty members. In the past, we have done odd pieces of work but this has not been an area of comparative strength. . .

For some years, we have sought to attract staff/students in this key area. Only recently have we been successful. Of our crop of 5/6 new Ph.D. students who arrived last October, I think 3 are planning theses on aspects of renewables. I think the greenhouse policy context accounts for this resurgence of interest . . . but, of course, it will be a year or so before they produce significant output."

John Chesshire
Head of the Energy Programme
Science Policy Research Unit
University of Sussex
January 28, 1991

"By 2020 we may expect renewables to contribute about 10 per cent of the total electricity needs of the IEA countries."

Sergio Garribba
Director, Research Office
International Energy Agency
Quoted in Financial Times
November 20, 1990

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Executive Summary

Renewable energy has taken on increasing importance in Western Europe during the period since the previous study for Energy, Mines and Resources Canada undertaken in 1988.* During the past two years, renewable energy policies have matured and expanded and there has been a significant increase in the deployment of renewable energy technologies in several countries. This activity should, however, not be overstated because it started from a very low base. Nevertheless, renewable energy is being given more of an opportunity to provide a greater share of its potential.

The two main driving forces behind these trends are the growing concern about environmental issues and the continuing concern about energy security. Energy security remains one of the overriding factors affecting energy policy in general. Europe is not energy rich and is highly dependent on imports of coal, oil and natural gas and thus, energy policy has been shaped by the desire to reduce vulnerability and costs. Environmental concerns were raised in the report two years ago but the importance has increased significantly in the intervening period. Nuclear energy concerns have increased. Italy, the Netherlands, Switzerland and the United Kingdom have had to delay any future expansion. Sweden has delayed the phasing out of nuclear but the decision to have it completely phased out by 2010 remains. France is the only country with a major nuclear energy expansion program although even that has been scaled back. The issue of global climate change and the need to reduce greenhouse gases (primarily carbon dioxide) have started a complete re-evaluation of energy options. Renewable energy technologies are being assessed in such a context and are coming out quite favourably.

While governments were active in providing support for renewable energy technologies two years ago, the support today is more comprehensive, directed and balanced. There is more emphasis on deployment of technologies, whether by targets or obligations or through emphasis on commercialization. There is still a strong emphasis on demonstrations and technology transfer. There are also policy changes due to the move towards integration of the internal market of the European Community which is to be completed by the end of 1992. This is forcing more competition in energy trade and technologies. It also provides the Commission of the European Communities with

* Rod Janssen, *Renewable Energy Policies in Europe*, August 1988

the opportunity to play a larger role both in on doing analysis on removal of market barriers and promotion of the development of energy technologies.

The question remains as to what realistic contribution renewables can make over the near to mid-term. There are still widely varying views, as would be expected. Yet, a reasonably firm foundation is being built and the potential is strong for a future that tightly integrates renewables to energy policy.

Importance of Renewable Energy

In 1988, non-hydro renewable energy accounted for 3.4 per cent of total primary energy requirements in Western Europe. This ranged from almost 17 per cent in Finland to an insignificant amount in the United Kingdom. It also represents a gain over the two previous years when the estimated contribution was about 1.8 per cent.**

More significant, however, are the projections of the contribution renewable energies are forecast to make in the year 2000. In at least seven countries, the forecast share of renewables has increased compared to forecasts made two years earlier. The share is still forecast to be relatively small, but, the increases reflect better assessments of what can and should be achieved.

Many countries have set specific targets for either renewables in general or for specific renewable energy sources (e.g. wind). In some cases the target has been set with utilities to install specific levels of capacity. This has ranged from 200 MW by 1994 in Denmark to 1000 MW by 2000 in the Netherlands.

Policies to Encourage Renewable Energy

Governments are using the full range of policy instruments to encourage the development and commercialization of renewable energy technologies. Many countries have **information** centres and the European Community is funding 33 centres to disseminate information on energy technologies (28 of which will provide information on renewable energy technologies. **Financial incentives** are still prevalent although some countries (e.g. Denmark) have decreased the incentives as the

** The data have to be treated with caution. There are still serious problems estimating the contribution because most renewable energy is non-commercial.

technologies become more commercialized. Germany, Italy and Spain, in particular, have increased the funding available for renewable energy technologies. **Regulations and standards** are still important because they have allowed renewable energy technologies to compete on more equal footing with conventional technologies. Most countries allow autoproducers of electricity to sell to the grid and even provide extra encouragement for electricity produced from renewable energy. The United Kingdom requires a certain amount of electricity to be produced from renewable energies.

Research, development and demonstrations still remain very important policy instruments and funding has increased in the past two years. In real US dollars, the funding has increased almost 27 per cent between 1987 and 1989 at the same time that Canadian funding decreased (in real US dollars). West European funding is still well below levels of the early 1980s. Nevertheless, renewable energy RD&D as a share of total energy RD&D ranges from over 80 per cent in Greece to less than 1 per cent in Belgium. Five countries have renewables representing over 20 per cent of total energy RD&D. This compares to only 4.2 per cent in Canada and 6.7 per cent in the entire IEA. Several countries have increased the share of renewables in energy RD&D in the past two years. The European Community is taking a large role and in two of its technology programs -- for research and demonstrations -- renewables represent 30-40 per cent of total funding for the next four years. There has been a shift towards more activity in wind energy and more towards commercialization and technology transfer efforts.

The **pricing** of electricity sold by autoproducers to the grid is also seen to have an impact on the deployment of renewable energy technologies and several countries have made the terms more favourable.

Major Findings

The major conclusions of the study are:

• renewable energy is now explicitly and integrally linked with energy and environment policies

• governments have expanded their programs in the past two years to encourage renewable energy technologies

• one of the major policy instruments used by governments is "negotiated targets" whereby targets for specific levels of installed capacity are agreed upon between governments and utilities

• many utilities are taking a more active role in deploying renewable energy technologies although often after considerable government encouragement

• the European Community is taking a more direct role, partially in the lead-up to the integration of the internal market by the end of 1992 and many countries are linking their programs with the EC in order to improve co-ordination and minimize overlap

• in general, priorities are shifting towards 1) technologies which produce electricity in general and 2) wind and photovoltaics in particular

• there has been some industrial restructuring of manufacturing efforts, particularly in the wind turbine industry

• the move towards the integrated European internal market is requiring greater standardization to minimize market barriers

• there are still a high number of commercial barriers in Western Europe affecting the export of renewable energy technologies amongst countries although these should be in part removed during the market integration process.

Lessons for Canada

There is a lot of activity in Western Europe. The move towards an integrated internal market in the European Community and the growing environmental concerns are speeding up the development and deployment of renewable energy technologies. Renewables are less of a "technology" issue than in years past. Many believe that institutional and marketing issues now need to be addressed. This is now being emphasized in several countries and the European Community.

There are many opportunities for Canadian renewable energy technology products to be marketed in Europe but the market is becoming more sophisticated and difficult to enter. But the market is also getting larger as more incentives and encouragement are provided. There are several trade fairs each year to display products and these will probably increase as more marketing emphasis is given to both renewable energy and Eastern Europe. However, the European Community with its network of technology information centres is aggressively marketing its own products. The

integration of its internal market by 1992 will also hinder access to outside competitors. Throughout Europe, there is an increasing number of manufacturers associations for specific technologies lobbying the European Community and adding credibility to its products. This all leads to a very dynamic situation that is changing rapidly.

Canada does participate in several multilateral renewable energy projects through the IEA but the opportunities also exist for more bilateral efforts. The United Kingdom has bilateral programs and the Danish folkecenter for renewable energy has expressed interest in co-operation with Canadians.

Résumé

L'énergie renouvelable a pris une importance croissante en Europe occidentale pendant la période écoulée depuis l'étude précédente pour le ministère de l'Énergie, des Mines et des Ressources entreprise en 1988.* Durant ces deux dernières années, les politiques de l'énergie renouvelable ont mûri, et se sont développées, alors que les technologies de l'énergie renouvelable se répandaient dans plusiers pays. Cette activité, cependant, ne devra pas être surestimée du fait de son niveau de départ excessivement bas. Néanmoins, on est en train de lui donner plus d'un atout afin d'obtenir une utilisation plus optimale de son potentiel.

Les deux principales forces motrices de ces tendances sont l'intérêt croissant porté aux problèmes de l'environnement et le souci constant de sécurité énergétique. La sécurité énergétique reste parmi les principaux éléments influençant la politique énergétique en général. L'Europe n'est pas riche en énergie et est grandement dépendante de ses importations en charbon, pétrole et gaz naturel. Par conséquent, sa politique a pour objectif de minimiser sa vulnérabilité et les coûts. Les problèmes de l'environnement déjà mentionnés il y a deux ans, se sont accrus. L'énergie nucléaire suscite davantage d'opposition. L'Italie, les Pays-Bas, la Suisse et le Royaume Uni ont retardé toute expansion future. La Suède a retardé l'élimination progressive du nucléaire mais l'échéance pour son arrêt définitif demeure 2010. La France est l'unique pays ayant un vaste programme d'expansion de l'énergie nucléaire bien qu'il ait été revu à plus petite échelle. L'émergence de la question liée au changement climatique et le besoin de réduire l'effet de serre a enclenché une complète réévaluation

* Rod Janssen, *Renewable Energy Policies in Europe*, August 1988.

des options énerétiques. Les technologies de l'énergie renouvelable on été évaluées dans un tel contexte en sont sorties favorisées.

Les gouvernements apportaient déjà il y a deux ans un soutien actif aux technologies de l'énergie renouvelable, mais ce soutien est aujourd'hui devenu plus étendu, plus ciblé et plus équilibré. On insiste davantage sur le déploiement des technologies, soit dans les objectifs, soit dans les engagements, soit qu'elles fassent l'objet de commercialisation. De gros efforts sont encore faits sur les demonstrations et le transfert technologique. On assiste aussi à des changements de politique du fait de l'unification du marché européen qui doit entrer en vigueur à la fin de 1992. Ceci conduit inéluctablement à une concurrence sur le marché de l'énergie et à une compétition technologique accrues. Cela va aussi donner l'opportunité à la Commission de la Communauté européenne de jouer un rôle plus conséquent aussi bien dans l'étude sur la suppression des barrières douanières que dans la promotion et le développement des technologies énergétiques.

La question reste à savoir quelle peut être la contribution des énergies renouvelables à court et moyen terme. Il y a toujours sur ce sujet des avis radicalement divergeants, comme on pourrait s'y attendre. Toutefois, la voie est tracée et l'avenir s'annonce favorable à l'intégration des énergies renouvelables dans la politique énergetique.

Importance de l'énergie renouvelable

En 1988, l'énergie renouvelable non hydroélectrique représentait 3.4 % du total des besoins en énergie primaire de l'Europe occidentale. Ce chiffre varie de 17 % en Finlande à un taux insignifiant au Royaume Uni. Il représente un gain par rapport aux deux années précédentes où la part était estimée à environ 1.8 %.*

Pour l'an 2000 les prévisions accordent un place encore plus importante aux énergies renouvelables. Dans au moins sept pays, la part prévue des renouvelables s'est accrue par rapport à celle qui avait été prévue il y a deux ans. La part prévue est toujours relativement faible, mais l'augmentation reflète une meilleure estimation de ce qui peut, et devrait être atteint.

De nombreux pays se sont fixés des objectifs précis soit pour les énergies renouvelables dans son ensemble, soit pour chacune des sources d'énergie (e.g. énergie éolienne). Dans certains cas, les

* Ces chiffres doivent être lus avec une certaine réserve. Il est toujours très difficile de faire les estimations de la contribution parce que l'énergie renouvelable est non-commercialisée.

objectifs ont été fixés avec les compagnies d'électricité dans le but de planifier des quotas de production. Ceux-ci varient de 200 MW au Danemark en 1994 à 1000 MW aux Pays-Bas en l'an 2000.

Les politiques d'encouragement de l'énergie renouvelable

Les gouvernements utilisent toute la panoplie d'instruments politiques afin d'encourager le développement et la commercialisation des technologies de l'énergie renouvelable. Beaucoup de pays ont des **centres d'information** et la Communauté européenne est sur le point d'en financer 33 autres afin de diffuser l'information sur les technologies énergetiques (28 d'entre eux fourniront des renseignements concernant les technologies de l'énergie renouvelable.) Les **incitations financières** prévalent toujours bien que quelques pays, comme le Danemark, ont diminué ces incitations du fait d'une commercialisation croissante des technologies. L'Allemagne, l'Italie et l'Espagne ont, notamment, accru les fonds destinés aux technologies de l'énergie renouvelable. **La règlementation et la normalisation** sont toujours importantes. La plupart des pays autorisent les producteurs indépendants d'électricité à vendre au réseau national et encouragent plus particulièrement l'électricité produite par l'énergie renouvelable. Le Royaume Uni exige qu'une certaine quantité d'électricité soit produite à partir d'énergie renouvelable.

La recherche, le développement et les démonstrations demeurent toujours un instrument de politique fondamental et les fonds qui y sont consacrés ont augmenté dans les deux dernières années. En dollars-US constants, ceux-ci ont progressé de presque 27 % entre 1987 et 1989 en même temps que les fonds canadiens diminuaient en dollars US constants). Les subventions en Europe occidentale sont toujours bien inférieures au niveau du début des années 80. Néanmoins, la part de l'énergie renouvelable en RD&D par rapport à celle attribuée à l'ensemble RD&D pour l'énergie varie de 80 % en Grèce à moins de 1% en Belgique. Cinq pays voient la part des renouvelables représentée à plus de 20 % du total énergetique en RD&D; comparativement à seulement 4.2 % au Canada et à 6.7 % pour le reste des pays de l'AIE. Plusieurs pays ont augmenté leur part de RD&D en énergie renouvelable dans les deux dernières années. La Communauté européenne joue un rôle croissant. Dans deux de ses programmes technologiques -- pour la recherche et les démonstrations -- les renouvelables représentent 30 à 40 % du total des fonds pour les quatre prochaines années. On manifeste plus d'efforts dans le secteur de l'énergie éolienne ainsi qu'en ce qui concerne la commercialisation et le transfert technologique.

La fixation du tarif de l'électricité vendue par les producteurs indépendants au réseau national est aussi considérée capable d'avoir un impact sur le déploiement des technologies de l'énergie renouvelable et plusieurs pays en ont rendu les conditions plus favorables.

Principales conclusions

Les conclusions principales de l'étude sont les suivantes:

• L'énergie renouvelable est maintenant explicitement et intégralement liée aux politiques de l'énergie et de l'environnement.

• Les gouvernements ont développé leurs programmes pendant les deux dernières années afin de mieux encourager les technologies de l'énergie renouvelable.

• L'un des principaux instruments poliques utilisés par les gouvernements est le système des "objectifs négociés" par lesquels des quotas spécifiques de production installée sont négociés entre les gouvernements et les compagnies d'électricité.

• Les compagnies d'électricité jouent un rôle plus actif en ce qui a trait à la diffusion technologique parce qu'elles sont parfois fortement incité à le faire par les gouvernments.

• Les compagnies d'électricité jouent un rôle plus direct, en particulier dans la conduite de l'unification du marché européen prévue à la fin de 1992 et plusieurs pays on lié leurs programmes à ceux de la Communauté afin d'améliorer leur coordination et d'éviter le dédoublement des activités.

• En général, les priorités s'orientent vers: 1) les technologies qui produisent de l'électricité en général et 2) les énergies éolienne et photovoltaique, plus précisément.

• On a assisté à une restructuration industrielle des efforts de fabrication, particulièrement dans l'industrie des turbines éoliennes.

• La création du marché européen exige une plus grande standardisation afin de minimiser les barrières commerciales.

• Il y a toujours en Europe occidentale un grand nombre de barrières commerciales affectant les exportations d'énergie renouvelable entre pays -- bien que celles-ci devraient partiellement disparaître avec l'intégration des marchés.

Les leçons pour le Canada

L'Europe occidentale est en pleine activité. L'unification commerciale et les préoccupations grandissantes pour l'environnement accelèrent le développement et le déploiement des technologies de l'énergie renouvelable; qui son plus accessibles qu'autrefois. Nombreux sont ceux qui croient que les problèmes institutionels et de commercialisation doivent maintenant être abordés. Cette idée prend aujourd'hui son essor dans plusieurs pays et dans la Communauté européenne.

Les occasions de commercialiser les produits énergétiques canadiens en Europe sont nombreuses même si le marché devient plus sophistiqué et plus difficile à pénétrer. Toutefois, le marché tend aussi à s'élargir grâce à l'augmentation des incitations et des encouragements ciblés. Il y a chaque année plusieurs salons commerciaux destinés à la présentation des produits et ceux-ci augmenteront probablement d'autant que l'on encouragera les échanges en Europe de l'est et que l'on accentuera la commercialisation de l'énergie renouvelable. Cependant, la Communauté européenne avec ses réseaux de centres d'information technologique, est en train de promouvoir aggressivement les produits européens. L'unification de son marché en 1992 gênera l'accès aux compétiteurs extérieurs. À travers l'Europe, on trouve un nombre croissant d'associations de fabricants de différentes technologies spécifiques faisant pression sur la Communauté européenne et renforçant la crédibilité de leurs produits. Tout ceci conduit à une situation très dynamique qui évolue rapidement.

Le Canada participe, à l'heure actuelle, à de nombreux projets multilatéraux sur l'énergie renouvelable par l'entremise de l'AIE, mais il existe aussi des possibilités pour plus d'efforts dans les projets bilatéraux. Le Royaume Uni a des programmes bilatéraux et le Folkecenter danois pour l'énergie renouvelable a exprimé son intérêt dans une coopération avec les Canadiens.

Chapter I

Introduction

The basic objectives for energy policy in Western Europe[1] have remained much the same for the past few years but there have been two dominant themes which have changed the situation considerably and thus the main priorities. In the past couple of years environmental issues have taken on even greater prominence, leaving no country unaffected. The 1991 Gulf war has shown how vulnerable countries remain to oil price and supply fluctuations. While these two issues were highlighted in the 1988 report on renewable energy policies in Europe, they have taken on a new perspective. The main question is whether there have been any significant changes to make a fundamental difference in the approach taken to encouraging renewable energy.[2]

Two other issues have taken on an importance that could not have been predicted two years ago: the integration of the internal market of the European Community and the effects of the transition of the east European countries from centrally planned to market economies. The integration of the internal market is leading to discussions on agreements on cross-border transit of gas and electricity as well as measures such as technical standards to remove market barriers. The developments in Eastern Europe have led to discussions about a pan-European energy charter, new programs to help the environment and energy situations and new opportunities for technology transfer and sales of equipment and know-how.

Energy security has meant greater efforts to rely on domestic resources (including renewables), more diversity of energy suppliers and more emphasis on energy conservation. Environmental issues have meant more interest of lower carbon-emitting fuels, new technologies to reduce emissions, more consideration of renewable energy and energy conservation. In effect, all options are being given due consideration although many countries have already stated their reaction to certain options such as nuclear energy, expanding hydropower or fossil-fueled generation.

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[1]The countries include Austria, Belgium, Denmark, Finland, France, Germany, Greece, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom. They are all members of the OECD. Finland was invited joined the International Energy Agency (IEA) in March 1991 and France in June 1991. Germany includes the former East Germany but no data are yet available for the unified Germany.

[2]The study excludes large-scale hydropower.

Renewable energy is making an inroad in a policy sense although in relatively small increments. If nothing else, it is not dismissed at once and serious analysis is being undertaken to determine what contribution it can likely make. The technologies are moving away from the laboratories and more into the market place. In many cases, their technical capability is better and work is underway to reduce costs to make them more competitive. Many countries have also made major policy statements in favour of encouraging the expansion of renewable energies. These statements have been specifically on renewable energy or part of a policy statement on the environment.

This paper will review the main energy policy issues now facing Western Europe and how renewable energy is considered in that context. Chapter III will then analyze the main barriers to the introduction of renewable energy technologies. This will be followed in Chapter IV by an assessment of the approaches governments have taken to overcome these barriers and increase the penetration of renewable energy technologies. Chapter V will review some of the major private sector activities to introduce renewable energy and Chapter VI will provide conclusions. Annex 1 provides country-specific details on energy policy in general and renewable energy policy in specific. Annex 2 describes the major programs of the European Community to encourage renewable energy.

The Energy Policy Context

Western European countries are not overly endowed with indigenous conventional energy resources. There is considerable reserves of coal but its exploitation has traditionally been heavily subsidized. Those subsidies are being phased out and the industry is contracting. The United Kingdom and Norway have sizeable oil and natural gas resources and the Netherlands has natural gas. Many countries have exploited hydropower although there is not much remaining potential. Several countries have developed nuclear energy to reduce import dependence. Table 1 shows a breakdown for total energy demand for the region reflecting the high dependence on imports.

Table 1
Energy Requirements
in Western Europe -- 1988
(mtoe)

	Coal	Oil	Gas	Nuclear	Hydro	Other	Total*
Domestic Production	174.2	206.0	147.3	154.8	105.5	34.0	821.8
Imports	88.8	697.4	103.4	--	--	12.2	901.8
Exports	13.4	295.2	47.4	--	--	11.3	367.3
TPER	251.7	578.7	203.6	154.8	105.5	35.0	1329.3

***The two columns do not add exactly because table excludes international marine bunkers and stock changes**
Source: OECD/IEA, Energy Balances of OECD Countries, 1987-1988.

A large percentage of the imports is oil and the recent Gulf crisis has shown the importance of maintaining oil stocks and having policies for energy conservation and oil substitution in particular. Oil does have a lower share of Total Primary Energy Requirements (TPER) but transport is still highly dependent on oil products and it is one of the fastest growing end-use sectors. Energy conservation continues to be an important element in energy policy as part of the energy security strategy. Interest in energy conservation generally waned in the late 1980s because of low oil prices although there was growing activity in southern Europe, a region which started very late to encourage efficiency. Greece still does not have a very effective program. The one area where energy conservation activities were lagging was in electricity. Demand side management programs are only recently starting to be taken seriously although there are still only a relatively few programs. Table 2 shows the changes in energy intensity of selected European countries between 1973 and 1988.

Table 2
Energy Intensity (TPER/GDP)
of Selected West European Countries

	1973	1988	Average Annual Growth Rate 1973-88
Austria	0.48	0.41	-1.1
Denmark	0.43	0.32	-1.9
France	0.45	0.37	-1.3
Germany	0.53	0.41	-1.7
Italy	0.44	0.32	-2.0
Netherlands	0.62	0.48	-1.6
Norway	0.56	0.44	-1.5
Spain	0.42	0.45	0.4
Sweden	0.59	0.52	-0.8
Switzerland	0.28	0.28	0
United Kingdom	0.57	0.41	-2.2
OECD Europe	0.51	0.41	-1.4
Memo Item			
Canada	0.77	0.64	-1.3

Source: International Energy Agency

Oil substitution has been important. In 1986 in Western Europe, oil represented 45 per cent of TPER down from almost 60 per cent in 1973. By 1988 this was down to almost 44 per cent although this was up from 1987, largely due to low oil prices. Table 3 shows the relative changes in fuel shares. The biggest gains were made by natural gas and nuclear energy.

Table 3
Changes in Shares of TPER
in OECD Europe
1973-1988
(%)

	1973	1988	Memo Item: Canada 1988
Coal	20.6	18.9	11.0
Other Solid Fuels*	1.8	2.6	2.8
Oil	59.8	43.5	31.5
Natural Gas	10.3	15.3	20.8
Nuclear	1.4	11.6	7.4
Hydro, etc	6.1	7.9	26.5

* **Includes peat, wood, wood waste, black liquor, industrial and municipal waste**
Source: OECD/IEA, Energy Balances of OECD Countries.

There are efforts to increase domestic energy production but there is only limited success. The Netherlands, Norway and the United Kingdom have the best opportunities to expand production. Denmark has an important but relatively small off-shore oil and gas industry but they are not able to export large quantities. There are various exploration activities in other countries but they do not show great promise. The alternative to imports is to improve energy efficiency or expand the use of nuclear energy[3] and/or renewable energies.

There have been other important energy policy issues in Europe:

- **Cross border trade in electricity and gas**

Energy Ministers of the European Community approved in October 1990 a directive which opens the exchange of electricity "between entities responsible for the gas and electricity grids." This is seen as one way to reduce the monopoly positions of utilities. The Ministers, however, did not approve a parallel directive for gas transit. Denmark, Germany and the Netherlands all have reservations and believe a high percentage of gas is already transported across borders. The gas proposal is expected to be approved in 1991. It is now being discussed in the European Parliament.

- **Moving towards an integrated internal market**

The European Community is moving towards a fully-integrated internal market in 1993 and energy has been included in that process. The internal market aims at establishing the free circulation of goods, persons, services and capital. The gas and electricity transit directives discussed above are part of that process. Also included are directives on price transparency, development of standards, opening public procurement processes and so on. There is still some market barriers to deploying technologies (such as wind turbines) but the fulfillment of the internal market should remove these.

- **European Charter**

The Dutch Prime Minister, Ruud Lubbers, proposed a pan-European energy community which would establish closer links between Western Europe, possibly the rest of the OECD and the Soviet Union and Eastern Europe. The Energy Community would include all Europe and not just the

[3]Nuclear energy is treated a domestic supply in IEA statistics although some individual countries do not consider it so.

members of the European Community. Such a community could provide financing and technology to help raise the output of Soviet oil and gas while at the same time providing a reliable, secure supply for the western region. The proposal for a Charter was recently approved by the European Commission and the first meeting was held in July 1991. It is expected to be approved before the endof 1991.

- **Increased competition in electricity production and distribution**

As discussed in the 1988 report, there has been growing interest in encouraging competition in the electricity supply industry either by letting generators openly compete for consumers (as in Britain) or encouraging third parties to sell excess electricity to the grid. This is slowly starting to change the structure of the industry because large utilities are able to defer or postpone investments by purchasing electricity for autoproducers. So far it has represented a relatively small proportion of production but the share is growing. Also, powerful utilities such as Electricité de France, which has steadfastly opposed such activity in France, has just relented and agreed to it.

Environmental Issues

The energy situation and policies, however, have been substantially affected by growing environmental issues. The early report prepared in 1988 described the importance of environmental concerns but they have have had a tremendous impact on energy policies in the interim period. All governments and international organizations have reacted with analyses and policy statements. The following summarize the main environmental concerns which are affecting energy policy.

- **Nuclear Energy**

Concerns about the safety, cost and waste disposal of nuclear energy have grown throughout the 1980s. Sweden was the first country to plan to phase out nuclear energy by the year 2010 and it was followed in particular by Austria, Switzerland, Italy, the United Kingdom and the Netherlands who cut back on expansion plans. Denmark had had nuclear energy as a viable policy option throughout the early 1980s but then removed it from policy consideration. Belgium and France have large nuclear programs but are encountering difficulties expanding. France has announced a further expansion to 2000 but less ambitious than earlier planned.

Countries such as Italy, the Netherlands and Switzerland effectively have moratoria. Switzerland's decision was reached by national referendum and extends for 10 years. The United Kingdom has delayed the decision on the possible expansion of nuclear power to 1994 and, with the privatization of the electricity industry, the government was forced to keep the nuclear energy component under government ownership, largely because of the cost concerns. Under privatization, Britain has a non-fossil fuel obligation (NFFO) which forces regional utilities to purchase a certain amount of electricity produced by nuclear or renewable energy, thereby protecting those industries. The NFFO was originally only for nuclear but, through public pressure, it was expanded to include renewables.

Sweden has recently announced that it will not begin phasing out nuclear in 1995 as previously planned. The government is under pressure to keep Swedish industry competitive and meet targets for carbon dioxide. It announced a package of incentives for energy conservation and renewable energy to compensate for the delayed phase-out. The government still holds to the deadline of 2010 for complete phase-out.

Austria built a nuclear plant but did not commission it. More than a decade later the government decided to dismantle the facility.

- **Climate Change, Emissions**

The global climate change issue has become a very important policy aspect for European countries. Most countries have adopted some form of target. The European Community has adopted a goal of stabilization of carbon dioxide emissions at 1990 levels by the year 2000 (the goal is EC-wide and some countries will not meet it until 2005 while others will exceed the target by 2000). The EFTA countries (Austria, Norway, Sweden, Switzerland) also adopted the EC target.

Many countries have published policy papers on environment (in particular Denmark, France, Ireland, the Netherlands, Sweden, and the United Kingdom). Norway is expected to publish one in 1991. All environmental policy plans refer to the importance of energy conservation and renewable energy in helping to overcome many of the emissions problems.

- **Noise, siting, etc.**

There are growing concerns about siting power plants, noise, etc. There have been problems about siting for hydropower and nuclear facilities, transmission systems, nuclear waste disposal and wind farms. These concerns are starting to paralyze certain utilities and reduce the number of options available. Some countries have banned certain rivers from being dammed (particularly Sweden). Other countries are having difficulties expanding the transmission system (Italy, Switzerland). Britain has expressed concern that it is having difficulty finding adequate sites for wind farms due to local opposition. Even Denmark with the largest wind energy program in Europe is having problems. The utilities announced to the government last year that they would be late for fulfilling their obligation to install 100 MW of wind generating capacity by 1991 because of problems with approvals from local authorities, due to a combination of public opposition and time-consuming bureaucracy. They asked for a national plan for siting. All countries with nuclear programs are experiencing public concerns over radioactive waste disposal.

How Seriously Are Renewables Being Taken?

The timing is ideal for most forms of renewable energy. Most energy options are being dismissed for high environmental impact and/or problems with energy security. Renewable energy is considered in many circles to be the hope for the future, especially as discussions centre around sustainable development. Others are more realistic and realize that renewables will contribute an important but probably relatively small proportion of total energy demand in 2000. Regardless, renewable is being taken more seriously and not being treated as a publicity stunt. Discussions now centre on getting costs more competitive, improving reliability and reducing environmental impacts.

The following chapter shows the share of renewable energy in total energy demand and the major policy statements that have been made by governments and others on its expected role.

Chapter II

Importance of Renewable Energy

There has been an important growth in the share of non-hydro renewables in the past few years and there is also an increase in the forecast for renewables compared to two years ago. At least Austria, Denmark, Greece, Ireland, Portugal and Switzerland are now forecasting a larger share for renewables in the year 2000 than they did two years ago and they have introduced programs to meet those goals.

Table 4
Energy Requirements and the Role of Renewable Energy
1988

Country	TPER (Mtoe)	% Renewables in TPER	Renewables (Mtoe)	Projected % for 2000
Austria	28.8	7.40	2.13	8.0
Belgium	45.9	0.30	0.14	0.3
Denmark	19.0	4.40	0.84	8.0
Finland	29.6	16.70	4.93	n.a.
France	208.9	4.60	9.60	3
Germany	274.1	3.00	8.22	3.2
Greece	20.5	6.10	1.25	10.0
Ireland	9.7	14.40	1.40	14.0
Italy	151.7	2.04	3.10	0.6
Luxembourg	3.3	0.80	0.30	0.9
Netherlands	64.5	0.28	0.18	3.6
Norway	28.0	3.30	0.92	3.0
Portugal	15.7	7.30	1.14	6.3
Spain	84.6	3.0	2.54	2-3
Sweden	56.2	11	5.55	10-11
Switzerland	23.9	3.50	0.82	4-5
United Kingdom	208.5	0.00	0.00	2-3
Total	**1272.9**	**3.38**	**43.06**	**n.a.**

Sources: IEA and various country sources

One sector which is making big gains is in electricity production. The largest individual scheme remains the tidal power facility in France (240 MW) and wind energy capacity in the European Community has surpassed 340 MW and this is expected to double by 1992. There is also over 600 MW of geothermal power plant capacity, mainly in Italy.

While there is more detail in Annex 1, some of the targets for capacity in renewable energy include:

- **Denmark**

  - target of 1300 MW of installed capacity of wind turbines by 2000. The utilities have agreed to install 100 MW by 1991 and a further 100 MW by 1994.

  - biofuels are targeted to meet 9 per cent of total energy demand by 2005. This is made up of straw, wood chips, biogas and organic household and industrial wastes.

- **Germany**

  - the Government has announced a new target of 250 MW of installed wind turbines, up from 100 MW. This is expected to further increase to 500 MW.

- **Italy**

  - geothermal -- It is expected that capacity will increase from 548 MW in 1989 to 885 MW in 1995.

  - wind -- Enel, the electric utility has set a target of 300 MW of installed wind generating capacity by 2000. This could be raised to 600 MW if large-sized turbines (larger than 1 MW) become available.

- **the Netherlands**

  - The government has set a target of 1000 MW of installed wind energy capacity by 2000. In an agreement between the government and seven provinces, 2000-3000 wind turbines will be installed before the end of the century. The first 1000 turbines with a total capacity of 400 MW are to be in operation by 1995.

- **Switzerland**

  - Under the new Energy 2000 program, the government wants 0.5 per cent of its electricity and 1 per cent of its heat in the year 2000 to come from renewables (non large-scale hydropower).

- **the United Kingdom**

  - The government has a target of 600 MW of installed renewable energy power capacity by 1998 under the Non-Fossil Fuel Obligation for the electricity industry. The first tranche of 170 MW was approved in 1990 and the second round for another 150-200 MW is to be approved in 1991.

  - The 1990 White Paper on Environment announced a target of 1000 MW of renewable energy capacity by the year 2000.

The IEA is currently preparing a report on *The Role of Renewable Energy-Based Electric Power in the OECD Region*. This report details existing facilities by fuel and presents plans for new plants.

Chapter III

Policies to Encourage Renewable Energy

Before discussing the main policies and programs in European countries it is useful to briefly describe the major barriers which are hindering the penetration of renewable energy technologies.

A Major Factors Affecting the Penetration of Renewables

- **Technical**

Most analysts believe that many of the technical concerns for several of the renewable energy technologies have been addressed. There is still concern about durability and reliability, problems which take time to find out because of the fairly recent introduction of these technologies. There is, however, research in such areas as materials, gear boxes and controls.

Linked with the issue of technical is technology transfer and relatively more effort is being given to spread information about the technologies and techniques.

- **Environmental**

There are continuing concerns about appearance, noise, siting, emissions and safety. There are growing concerns about wind turbines in terms of siting wind farms in particular both on land and offshore, noise and safety. So far, renewable energy technologies have been deployed on a relatively small scale. There are worries that there will be public reaction against large-scale deployment.

- **Economics**

Concerns over reducing costs and making renewable energy more competitive. Costs have come down considerably for many renewable energy technologies in the past years but there are many who feel that more research and development is needed to bring them down even further.

- **Social/Attitudes**

In many ways general attitudes are quite favourable towards renewable energy especially as the public reviews the options available to address, in particular, environmental problems. There are, of course, environmental groups who have been lobbying hard for renewable energy to be taken as a more serious option and, in many ways, they have been quite successful in turning government policies around. Many political parties are also giving renewable energy serious consideration. This is very much the case for virtually all the parties in Scandinavia. In other parts of the region there does not seem to be much difference between the government and opposition parties in their approach. The shadow energy secretary of the British Labour Party has recommended a separate government renewable energy agency but the general view of the Labour Party is acceptance as long as it does not adversely affect the coal industry. In many countries, the differences centre more on how it is going to be financed because there are still rather severe budget restrictions.

One of the problems Britain faced was that the former Prime Minister, Margaret Thatcher, was convinced by the environmental argument but administration officials had difficulty recommending policies because of her free market philosophy.

Utilities are by their nature fairly conservative and have generally not been well disposed to investing in renewable energy technologies other than large-scale hydropower. Without being required to invest they will not in any meaningful way.

Overall, there is still an attitude that renewables may be important for niche markets but that they will not play a significant role in TPER in the medium-term.

There is also a perception problem resulting from data limitations. Partly because a high proportion of renewable energy used is non commercial and partly because it is often combined with large-scale hydro power or solid fuels, the true contribution is not known or appreciated. This can have a definite perception problem for policy makers and the public as a whole.

- **Markets and Manufacturers**

It is still an infant industry and many of the manufacturers are small or inexperienced. Many industries, such as for wind turbines, have gone through major restructuring. For example, there are now only about 30 major manufacturers when there had been several hundred only a couple of years ago. There have been trade restrictions to protect domestic industries but the integration of the European market will effectively bring an end to that. The restrictions were more normal, however,

during research and demonstration stages. As technologies move out into full commercialization, the restrictions should end.

There are now many manufacturers/interest group associations which are lobby groups to promote their industry. They exist for all the major renewable energies (wind energy, photovoltaics, biomass, and micro-hydaulics). One of the most recently formed is the European Committee for Biofuels which groups the national associations from Belgium, France, Germany, Italy and the Netherlands. jAfter several attempts to have a European-wide organization for renewable energy, the European Federation of Renewable Energies was formed in February 1991. The purpose is to promote renewable energies through training and public education, workshops, international campaigns, communicating with national, European and international authorities, and conduct studies and publish periodicals.

- **Institutional**

There is still a bias against renewable energy. Some renewable energy technology manufacturers complain that, for example, nuclear facilities could be written off over 30 years while their facilities had much shorter periods of support. This is the case in Britain with the NFFO which only gives renewable energy technologies support for a maximum of seven years when the obligation terminates in 1998..

B Policies to Encourage Renewable Energy

As discussed in the preceding chapters, governments are increasingly involved in analyses and programs to encourage investments in renewable energy technologies. Activity ranges from basic research through to encouraging commercialization. The following represents some examples of measures that governments are taking[4]:

- **Information and Dissemination**

Most countries do provide information on renewable energy technologies. Some of the major efforts include:

- **Denmark** has the Folkecenter for Energy Conservation, a private organization partly funded by the government to "promote information dissemination and know-how and to develop renewable energy

[4] More country-specific information is available in Annex 1.

techniques with a special view to production and employment within small and medium-scale industries." The folkecenter also works with developing countries.

- **France** has the Agence Française pour la Maîtrise de l'Energie which provides a comprehensive package of information, both centrally and through regional offices. It also has the "Minitel" telephone-linked computer service to provide information on solar and other renewables.

- **Greece** has the Centre for Renewable Energy Sources which is a centre of excellence for Greece and the European Community as a whole and disseminates results.

– The **Netherlands** has the Netherlands Organization for Energy and Environment (NOVEM) which provides information on renewables.

- **Portugal** has the Biomass Centre which undertakes research and provides information.

- **Spain** has the Renewable Energy Institute which has a comprehensive information program including publications, workshops and training.

- The **United Kingdom** has the Renewable Energy Enquiries Bureau at the Energy Technology Support Unit (ETSU) in the Atomic Energy Authority which provides general and technical advice on renewable energy.

- The **Commission of the European Community** is giving high priority to information and disseminating the results of its research and demonstrations. First there is SESAME which is an on-line data base providing information on energy savings, renewables, hydrocarbon technologies, liquefaction and gasification, and new use of solid fuels, electricity and heat. Currently the Commission is establishing a network of Opets (Organizations for the Promotion of Energy Technologies) under its Thermie demonstration program. Many of these Opets are existing government conservation and renewable energy centres such as the French Agence Française pour la Maîtrise de l'Énergie. Thermie covers renewables, energy saving, etc. The budget for dissemination is over C$31 million per year. Twenty-eight of the 33 Opets provide information on renewable energy technologies. They are giving a high priority to disseminating results to Eastern Europe.

• **Financial Incentives**

Most countries are now providing some form of financial support to encourage investments in renewable energy.

- **Austria**

  - tax incentives for consumers to invest in autogeneration of electricity from waste heat, solar installations, wind generators, waste heat recovery systems, the use of biomass, insulation and heat pumps. There is also financial support for district heating.

- **Denmark**

  - Denmark has provided financial incentives for wind turbines but reduced the percentage over the years as the turbines became more cost-effective. It is now 10 per cent of installation costs as of January 1, 1989 for wind turbines and heat pumps. Other renewables can receive a subsidy of 30 per cent of approved costs. There is also a 35 per cent subsidy for connection to the grid.

  - There are indirect subsidies for straw-burning, biogas, wood chip and refuse incinerator plants by consumer taxes on oil and coal.

- **Germany**

  - The government also provides financial credits for plants investing in renewable energy technologies. As of January 1, 1991 the government raised the minimum price for electricity produced from renewable energy sold to the grid to make renewables more competitive.

- **Greece**

  - There are subsidies for autoproducers of electricity from renewable energy. The grants can vary from 40 to 55 per cent depending on the location. Greece depends heavily on funding from EC programs.

- **Italy**

  - Subsidies between 20 and 40 per cent will be available for improving energy use in buildings. This includes heat pumps and systems using renewable energy for heating or hot water heating which supply at least 30 per cent of needs. The subsidies will be up to 80 per cent for photovoltaics.

- There are subsidies up to 50 per cent for feasibility and design studies for energy derived from cogeneration.

- There are also subsidies of 30 per cent for investments in renewable energies for cogeneration and further subsidies of 55 per cent for using renewable energy in agriculture.

- Luxembourg

- provides subsidies for renewable energy technologies. The subsidies cover 25 per cent of the costs.

- Netherlands

- subsidies are provided for wind energy investments. Subsidies to manufacturers for up to 70 per cent of the cost of developing turbines with rotor blades longer than 12 metres have been discontinued and replaced with purchaser subsidies of 35 per cent. These new subsidies will continue until 1994 but will be reviewed annually.

- under the conservation and renewable energy program announced in the *Memorandum on Energy Conservation*, subsidies will be given for solar-powered hot water appliances and solar cells.

- Spain

- The PER provides for subsidies for investments in renewable energy. For the period 1989 to 1995, the budget allocated is 35,514 million pesatas (C$ 433 million) for a total investment of 146,440 million pesatas (C$ 1.786 billion).

- Sweden

- There is also tax relief and investment grants for cogeneration plants, many of which are to be fueled by renewable energies. There are also grants for small-scale wind power units and solar heating plants. There is also a Fund for Energy Technologies which provides funding for studies, lab scale tests, pilot plants, and full scale demonstration plants where no funding is available. The Fund never provides more than 50 per cent to a project.

- **Switzerland**

  - Financial incentives are available for renewable energy and waste utilization. Many cantons also provide incentives.

- **United Kingdom**

  - Britain subsidies renewable energy projects under the NFFO until 1998. It is expected that the government will be requesting the government to have that date extended.

• **Regulations and Legislation**

Most of the regulations described in the 1988 report are still valid. Since then, some countries such as Italy and Spain, in particular, have formalized renewable energy programs through legislation (see Annex). The report prepared in 1987 by the European Community on regulations and legislation still stand. Of course, there will be changes in the European Community because of the 1992 internal market deadline. This will be particularly true for standards and transborder trade. There have been some changes in certain countries:

- **Denmark**

  - Denmark has formally banned burning straw in fields and more is becoming available for producing energy.

- **France**

  - Electricité de France, the country's electric utility, has finally agreed to allow autoproducers of electricity to sell to the grid. This will take effect in 1994.

- **Italy**

  - In December 1990 the strategy for rational use of energy and renewable energy under the PEN was approved. It includes many incentives to encourage the commercialization of renewable energy technologies.

- **Norway**

  - As of January 1, 1991 the government has approved the deregulation of the electricity industry which, in part, will make it easier for autoproducers to sell electricity to the grid.

- **Spain**

  - The most recent National Plan for Renewable Energies (PER) was approved in 1989, covering the period to 1995. It is an action plan to substantially increase the share of renewable energy in total energy demand and encourage Spanish industry to compete domestically and abroad.

- **Sweden**

  - There is a Parliamentary decision to phase out nuclear but the phase out period has been made more flexible which now depends on progress in energy saving, renewable energy and maintaining international competitiveness.

- **Switzerland**

  - The government announced "Energy 2000" in September 1990 to support energy conservation and renewable energy. The program was presented to Parliament in February, 1991 and is being defined later in 1991. It will combine both federal and cantonal measures, primarily for demonstrations, dissemination and information.

- **United Kingdom**

  - The terms of the privatization of the electricity industry requires a certain non-fossil fuel obligation (NFFO). This initially means requiring the regional utilities to supply a specified amount from nuclear energy and renewable energy. The obligation is to end in 1998.

• **Research, Development and Demonstrations**

A major part of government activity to deploy renewable energy technologies is in the R&D and demonstration stage although there is a shift in emphasis towards demonstrations due to the relative maturing of the technologies.

Table 5 shows the budgets for most Western European countries for government-sponsored research, development and demonstrations. Funding still remains much lower than the early 1980s but it has increased in the past few years. In the past two years, the budgets in US dollars have gone up for nine countries and down for five. A number of countries expect their budgets to drop in 1991.

For 11 countries, the budgets for renewable energy research, development and demonstrations represent a larger share of total funding for energy R,D and D than two years ago although the IEA average remains the same.

For the European Community's non-nuclear energy research and demonstration programs, funding for renewables represents about 30-40 per cent.

Table 5
Government Research, Development and Demonstration Budgets
For Renewables
(Millions of 1989 US$)

Country	1978	1980	1982	1984	1987	1989
Austria	6.8	9.5	6.9	3.9	2.8	2.2
Belgium	2.4	10.5	8.1	13.4	3.9	0.4
Denmark	8.0	7.2	4.7	4.3	4.5	9.4
Finland	4.1	5.9	14.4	11.0	n.a.	8.1
France	n.a.	n.a.	n.a.	86.6	15.3	5.9
Germany	39.3	90.0	143.6	84.2	66.0	93.2
Greece	0.8	10.1	3.3	4.5	5.1	17.1
Ireland	0.9	1.9	5.1	1.1	1.2	n.a.
Italy	14.3	26.5	24.7	86.6	33.4	36.5
Netherlands	17.3	22.4	25.9	24.4	19.7	18.7
Norway	3.0	5.8	3.7	3.2	2.6	7.9
Portugal	n.a.	1.1	1.4	2.8	1.8	2.2
Spain	6.2	36.8	27.0	57.8	10.9	6.9
Sweden	34.4	58.0	70.7	48.9	17.0	19.3
Switzerland	8.2	12.5	11.1	11.8	11.1	18.3
United Kingdom	18.5	28.8	31.2	27.4	22.8	23.7
Total	160.1	321.1	367.4	374.3	201.5	255.8
Memo Item: Canada	43.4	50.1	65.0	55.9	16.4	14.9

Sources: IEA, Energy Policies and Programmes of IEA Countries, 1989 Review; AFME Rapport D'Activité 1988 and 1989; Energy Research in Finland.

Table 6
1989 Renewable Energy
Research, Development and Demonstration Budgets

Country	Renewable RD&D (mill U.S.$)	Share of renewables in Energy RD&D %
Austria	2.24	16.7
Belgium	0.43	0.9
Denmark	9.37	28.1
Finland	8.10	55.0
France	5.90	n.a.
Germany	93.24	18.9
Greece	17.07	86.2
Ireland	n.a.	n.a.
Italy	36.52	5.9
Netherlands	19.66	14.8
Norway	7.87	17.3
Portugal	2.19	31.1
Spain	6.87	13.3
Sweden	19.31	21.3
Switzerland	18.28	18.1
United Kingdom	23.65	7.1
Total	256.7	n.a.
Memo Item:		
Canada	14.95	4.2
IEA	489.40	6.7

Sources: IEA, Energy Policies and Programmes of IEA Countries, 1989 Review; AFME Rapport D'Activité 1988 and 1989; Energy Research in Finland.

Priorities

Overall, priorities have not changed markedly in the past two years (see Table 7). Funding for wind energy has gone up but there are no significant changes.

Countries do state that there are some changes in priorities. Some countries (such as Austria and Norway) are concentrating more studies on the factors to increase the penetration of renewable energy technologies. They feel there is adequate research and demonstrations and that it is time to better understand and overcome the commercialization barriers. This view is somewhat supported by

the actions of the European Community which is undertaking a major study to determine the true potential for renewable energy, factoring in all the market barriers.

Many countries have advisory boards of outside experts (industry, universities, etc) to help set priorities.

There also appears to be a shift towards wind energy and photovoltaics. Wind energy appears to be gaining ground throughout the entire region. After 1988, Britain withdrew its support for photovoltaics stating that it was a "long-shot." However, they now believe the economics has changed sufficiently for them to reconsider that position. The Netherlands is also slightly shifting its attention more towards photovoltaics. Funding for photovoltaics represented almost 70 per cent of the budget for solar in 1989, up from under 37 per cent in 1980.

The rationale for the priorities have not changed substantially in the past two years. The following represent the main reasons for the research priorities:

- **need for environmentally-benign technologies**

  - The push for to have environmentally-friendly generating systems serves as an impetus for efforts in renewable energies. It is understood that renewable energy technologies are not impact-free but most do not emit carbon dioxide and other greenhouse gases during operation -- a major concern today.

- **potential contribution to national energy demand**

  - Several countries state that priority is given to those areas which show the greatest promise for domestic production (e.g. Denmark, Finland, Italy, the Netherlands, Portugal, Spain and the United Kingdom). (see annex for national priorities)

- **producing electricity is major concern**

  - While using renewables for water and space heating is important, the increasing share of effort is in technologies to produce electricity.

- **reducing costs**

  - Many governments state that technologies have come a long way technically but that further development and demonstration is needed to reduce their costs and make them more

commercially viable. Nevertheless, renewable energy technologies are seen as important contributors to avoiding environmental costs.

- **development of national capability to compete domestically and abroad**

  - Several countries, such as Denmark, the Netherlands and Spain (although it is hard to exclude any) explicitly state that their support for renewable energy technologies is to build up the national industrial base.

- **support for developing countries**

  Several countries (particularly Denmark, France, Germany and the Netherlands) have large programs to support developing countries with their own renewable energy technologies. Germany explicitly states this as one of their objectives. The Netherlands recently installed photovoltaic systems in 300 individual homes in Indonesia and are expanding this to 3000 homes. The project was initiated by a photovoltaic manufacturer in Holland who asked for support from the government. The foreign ministry was not interested but the Economics Ministry, which is responsible for energy policy, did support it. In France, it is the agency responsible for energy conservation and renewable energy which deals directly with foreign countries. It is not done through any aid agency. Denmark provided $50 million worth of wind turbines for one project. The Folkecenter for Renewable Energy has many training and exchange programs with developing countries. Virtually every program of the European Community has a component dealing with non-Member countries. Many of the programs deal directly with Eastern Europe and now many of their analyses (for example, to study the potential for renewable energy) include the East.

  Such aid programs are very useful as demonstrations for technologies but they are also useful to promote regional technologies.

Table 7
Share of Renewable Research, Development and Demonstration -- 1989
(Per Cent)

Country	Solar*	Wind	Biomass	Ocean**	Geothermal
Austria	23.2	1.8	75.0	0	0
Belgium	76.7	0	11.6	0	11.6
Denmark	6.0	71.9	17.7	4.4	0
Finland	n.a.	n.a.	n.a.	n.a.	n.a.
France	50.6***	***	28.1	n.a.	21.3
Germany	79.6	19.4	0.1	0	1
Greece	13.7	45.3	2.2	0.4	38.4
Ireland	n.a.	n.a.	n.a.	n.a.	n.a.
Italy	38.2	46	15.8	0	0
Netherlands	32.8	31.9	20.9	4.8	9.6
Norway	9.5	12.7	18.4	7.37	52
Portugal	50.7	8.7	31.1	6.4	3.2
Spain	29.5	7.9	51.1	0	11.5
Sweden	34.4	30.9	33.2	0	1.6
Switzerland	65.9	2.4	12.7	0	19.1
United Kingdom	13.2	37.8	19.6	8.3	21.1
Memo Item: IEA Averages					
1977	59.6	9.9	4.3	5	20.3
1980	54.7	9.6	7.6	6.2	21.9
1987	49.5	14.7	17.1	2	16.6
1989	48.1	17.4	15.6	1.9	16.8
Canada Avg					
1987	30.1	10.9	56.6	1.2	1.2
1989	29.4	11.3	54.8	2.8	1.7

*** Includes solar heating and cooling, solar photo electric and solar thermal electric**
**** Includes wave, tidal and ocean thermal energy conversion systems**
***** No breakdown available for solar, wind and small-scale hydro.**
Sources: IEA, Energy Policies and Programmes of IEA Countries, 1989 Review; Agence Française pour la Maitrise de l'Energie Rapport D'Activité 1988 and 1989.

• Program Delivery

The biggest single change since the 1988 report has been the creation of a network of 33 Opets under the European Community (28 of which provide information on renewable energy). The European Commission ensure that information is well co-ordinated but the language and the style is left up to the Opet. The Opets are only in the phase of becoming operational and it will take some months to see how effective they are.

Many countries have one centre reporting to the ministry responsible for energy or research which co-ordinates the implementation of programs, providing information, etc. This is particularly true in Denmark, France, Greece, the Netherlands, Portugal, Spain, Sweden and the United Kingdom. Germany has a research ministry which is separate from the ministry responsible for energy.

e) Pricing of Electricity Sold to Grid

The price that autoproducers receive can have a strong impact on the deployment of renewable energy technologies for such purposes. Since the 1988 report, a few countries have changed the conditions.

- Belgium

- The terms and conditions are set out in a series of recommendations made in 1985 by the Comité de Gestion des Entreprises d'Electricité. For power sold by autoproducers to the grid, the price paid reflects saved fuel costs and eventually a saved capacity premium. The price also depends on time of day. An autoproducer receives a capacity premium if at least 50 per cent of the average output during day hours is continuously available to the grid.

- Denmark

- Surplus production is bought by the utility at a rate of 70 per cent of the utility's net selling price to ordinary domestic customers. Electricity produced by renewables are exempted from the value added tax (VAT) and a special electricity tax. Electricity produced from renewables and sold to grid may receive DKK 0.23 (C$0.0393) per kWh. With the VAT reduction and the special electricity tax, the total subsidy is DKK 0.3965/kWh (C$0.0677).

- France

- Electricité de France has recently given up its objection to purchasing electricity from autoproducers. The practice will now be allowed as of 1994 and the utility will pay at the "avoided cost."

-Germany

- Support is given at the rate of DM 0.06/kWh (C$0.0393) for electricity fed to the grid. Total support is now DM0.247/kWh (C$0.162).

- **Greece**

  - Private autoproducers of electricity are now allowed to sell all their production to utilities (up from two-thirds). The price is mutually agreed upon between the producer and the utility.

- **Italy**

  - Autoproducers of electricity with capacity up to 3000 kW can sell to the grid. The price depends on the time and season. If the exchange occurs during the same time or season, the buy-back and selling tariffs are identical. If the autoproducer supplies, for example, during peak winter hours and consumers receive power from the grid during winter night hours, the power sold to the grid is valued at 130 per cent of that which the grid supplies.

- **the Netherlands**

  - as stated in the policy statement of June 1990, the payment to be made to private operators for supplying electricity is to be raised throughout the country "to the level of the average cost which the distribution companies are enabled to save on the public supply as a result. This payment will be calculated in accordance with Article 42 of the Electricity Act 1989, in such a way as to be most beneficial to expanding the application of wind energy and other renewable energy sources.

- **United Kingdom**

  - Autoproducers can sell to the grid and under the newly structured electricity industry, after privatization, preferable tariffs are available for those who produce from non-fossil fuels.

Chapter IV

Conclusions

There are several conclusions which can be derived from the review of renewable energy policies in western Europe.

1. Renewable energy is now explicitly and integrally linked with environmental policies. There are more serious efforts to fully assess what realistic contribution renewable energies can make in the near to medium-term. Although there is a tremendous amount of skepticism for technical, cost and availability reasons, renewable energy is now being given a more realistic opportunity to prove itself in the marketplace. It is being given this chance largely because of growing environmental concerns and heightened public awareness.

2. Governments have expanded their programs in the past two years to encourage renewable energy technologies. Relatively more priority is being given to demonstration programs and promotion of technologies. While funding is down considerably from the early 1980s, many countries feel that this is to be expected because technologies are technically proven and that it is now important to reduce costs and improve their competitiveness.

3. One of the most effective policy instruments used by governments now appears to be "negotiated targets" whereby targets for specific levels of installed capacity are set. Denmark and the Netherlands have both come to agreements with utilities or local authorities to achieve such targets. Germany has set a target for which it will provide subsidies.

4. Utilities are taking very active roles although often reluctantly. Austrian, British, Danish, Dutch , Italian and Swedish utilities in particular are actively installing renewable energy technologies. There is a hesitancy and skepticism because there is often the feeling that these technologies are only minor and that the bigger technologies, especially nuclear, should be deployed

more. Vattenfall in Sweden worked on renewable projects but appeared to be more interested in keeping the nuclear option alive. With the decision not to phase out nuclear as quickly as originally planned, Vattenfall's hopes have somewhat come true, but at the expense of having to see what the true potential for renewables is. After privatization in Britain, the 12 area distribution companies have the obligation to purchase a certain amount of non-fossil fuel generated electricity but the two main generating companies have no obligation to produce electricity from renewables. Thus to two large generators have virtually abandoned their programs. Electricity from renewables is mainly coming from autoproducers. Some utilities, such as in Holland, however, have been innovative by co-ordinating their renewable projects in order to reduce costs and efforts.

5. The European Community is now heavily involved and many countries link their programs in order to improve co-ordination and minimize overlap. The EC does get advice on projects but there does not appear to be any global priorities. It is virtually "first come first serve" as long as the proposal is high quality. They work quite closely with potential contractors to ensure proposals are of high quality.

6. In general, priorities are shifting 1) towards technologies which produce electricity in general, and 2) towards wind and photovoltaics in particular. Electricity production in general is a major topic in Europe as environmental and organization issues arise. There is growing interest in photovoltaics because costs are coming down significantly and a large market potential is perceived, thus resulting in good industry possibilities. Wind energy technologies are being installed in several countries and the industry is becoming highly competitive. Small-scale hydro is important in a few countries but the technology is maturing and it is now more a question of improving penetration. Active solar, particularly for hot water heating, is important in the more southernly regions but those are not the countries with the large technology programs. There are strong feelings that bioenergy will become a high priority in the future but that is not the case so far. Priorities have sharpened, especially since budgets are smaller than in the early 1980s. However, there has been a big shift away from research *per se* towards marketing. This includes better understanding the market barriers in order to increase technology penetration.

7. There has been some industrial restructuring of manufacturing efforts. Renewable energy technologies are becoming more mature and accepted. The biggest restructuring has been in the wind turbine industry which had hundreds of manufacturers only a few years ago to about 30 now. Many of the companies merged to form larger ones. This move has somewhat been

necessary because there is a demand for bigger wind turbines (300 to 500 kW) which requires more capital, development costs and sophistication.

8. The move towards the integrated European internal market in 1992 is requiring greater standardization to minimize market barriers. The efforts are largely being directed by the European Commission and they include standards development, major studies on technical and market potential for renewables and development of new programs such as ALTENER which is expected to be approved in 1992 and will be designed to address many institutional and infrastructure barriers. Standards being developed concern such issues as safety, noise, power performance determination and design.

9. There are still a high number of commercial barriers. There is relatively little cross-border trade of technologies. The European Commission will be analyzing the barriers but, to this point, is not unduly worried because renewable energy technologies have been in the development and demonstration stages which means that funding has been available to develop national capability. There are others, however, who feel those barriers will be hard to overcome. It makes it very hard for countries such as Canada to export technologies except in specialized niche markets. There would be the possibilities of joint efforts for Canadian companies.

10. There is limited scope for Canadian co-operative efforts. There are some possibilities for bilateral programs -- especially with Britain. The Danish Folkecenter for Renewable Energy is interested in co-operation with organizations or companies in Canada. There is the possibility of expanded efforts in conjunction with the collaborative research programs of the International Energy Agency. There is also possible scope for Canada to participate in standards development in Europe.

ANNEX 1

COUNTRY REVIEWS

1. AUSTRIA

A Introduction

Energy Demand and Role of Renewables

	TPER (mtoe)	% Renewables	Projected % in 2000
1986*	27.8	6.7	5.1
1988**	28.8	9.4	8.0

* Projection made for 1988 report, Renewable Energy Policies in Europe
** Latest projection

General Energy Policy and Relative Importance of Renewable Energy

Austria's energy situation is influenced by declining domestic production of fossil fuels, increasing difficulties in exploiting its hydropower resources and possibly growing dependence on imported energy.

In November 1984, the Federal Government issued a new "Energy Concept" which gave a long-term perspective to Austrian energy policy and defined the goals for the next 20 years. These included:

-availability of sufficient energy supply and energy security;

-compatibility between energy policy and environmental and social policy;

-reduction of energy imports and no increase in total primary energy requirements, mainly by way of energy conservation and efficiency;

-increased use of renewable energies; and

-substitution of expensive fuels and energy technologies through cheaper alternatives.

An Energy Report was prepared in 1990 stressed market forces and European integration but renewable energy still remains a high priority.

Use of renewable energy is considered an essential element in Austria's strategy to reduce CO_2.

B Energy R&D, Demonstration and Dissemination Policy and Importance of Renewable Energy

Objectives

The general guidelines for energy R&D and demonstration policy was published in 1980 and were integrated into the Energy Concept of 1984. The principal aim is to reduce dependence on imported primary energy. Thus, there is a strong emphasis on renewable energy technologies.

The focus is on near-term R&D without neglecting long-term R&D. Given the limited size of the Austrian market and the scarce resources available, adaptation and implementation of new

technologies developed elsewhere are of major importance. At the same time, export of Austrian-developed technologies is also stressed.

Priority is now being given to improving market penetration because there are many technologies which have been demonstrated and are economically viable but which have not achieved their full economic potential.

Major Policy Instruments Used

Austria provides tax incentives for consumers to invest in autogeneration of electricity from waste heat, solar installations, wind generators, waste heat recovery systems, the use of biomass, insulation and heat pumps. There is also financial support for district heating.

Level of Funding for R&D and Demonstration for Renewables

In 1989 the budget for renewable energy R&D and demonstration was US$2.24 million. This represented 16.7 per cent of total R&D and demonstration funding. The shares of funding amongst the various technologies were (%):

Solar	23.2
Wind	1.8
Biomass	75.0

The budget for 1991 is expected to decrease.

C Program Delivery

The Federal Ministry for Economic Affairs is responsible for energy policy while energy R&D and demonstration policy is co-ordinated by the Federal Ministry for Science and Research. Relevant R&D activities are carried out by universities and other research establishments.

D Major Policy and Related Documents Available

IEA, *Technologies for Energy Efficiency and Fuel Switching: Austria's Developments of Energy-Efficient Buildings Using Heat Pumps and Renewable Energy Technologies*, Paris, 1988

2. BELGIUM

A Introduction

Energy Demand and Role of Renewables

	TPER (mtoe)	% Renewables	Projected % in 2000
1986*	44.4	0.41	N.A.
1988**	45.9	0.3	0.3

* Projection made for 1988 report, Renewable Energy Policies in Europe
** Latest projection

General Energy Policy and Relative Importance of Renewable Energy

The main points of Belgian energy policy are:

- security of supply guaranteed by means of geographic and fuel diversification,
- rational use of energy
- transparent energy prices based on costs economic, energy, social and environmental factors,
- improved management of strategic petroleum stocks, and
- new development plan for electricity generation.

Renewable energy is not a high priority in Belgium. Since 1988, responsibility for renewable energy is under the regional governments.

B Energy R&D, Demonstration and Dissemination Policy and Importance of Renewable Energy

Objectives

The main priority is given to nuclear safety, waste and fusion technology. The objectives of renewable energy RD&D are currently being defined by the regional governments.

Major Policy Instruments Used

Because of the state of the programs, no information is available.

Level of Funding for R&D and Demonstration for Renewables

In 1989 the budget for renewable energy R&D and demonstration was US$0.43 million. This represented 0.9 per cent of total R&D and demonstration funding. The shares of funding amongst the various technologies were (%):

Solar	76.7
Biomass	11.6
Geothermal	11.6

C Program Delivery

RD&D programs are delivered by the regional governments.

D Major Policy and Related Documents Available

None

3. *DENMARK*

A Introduction

Energy Demand and Role of Renewables

	TPER (mtoe)	% Renewables	Projected % in 2000
1986*	19.7	3.6	5.4
1988**	19.0	4.4	8.0

* Projection made for 1988 report, Renewable Energy Policies in Europe
** Latest projection

General Energy Policy and Relative Importance of Renewable Energy

Danish energy policy has been based on reducing oil dependence by developing indigenous energy sources, converting power plants from oil to coal, expanding the use of combined heat and power (CHP) and district heating (DH), and improving overall energy efficiency.

In 1990, the Danish government came out with its comprehensive new energy plan called *Energy 2000, A Plan of Action for Sustainable Development.* The overall aim of the plan is: to create the basis for reducing CO_2 emissions by 20 per cent and then achieving a further reducing of SO_2 and NO_x emissions from their 1988 levels by 2005, while at the same time ensuring that Danish society is furnished with a reliable, efficient and economical supply of energy."

The government is establishing a Committee for Renewable Energy made up of both government and non-government experts which will provide advice.

The utilities agreed to install 100 MW of wind turbines by 1991 and a further 100 MW by 1994. The "Energy 2000" action plan sets a target of 1300 MW by 2000.

A new minority government was elected in 1990. The government does not want to support the short-term objectives of Energy 2000 and thus some activities are being held back. There has, however, been an increase in R&D funding. More emphasis is being given to consumer behaviour and market penetration.

B Energy R&D, Demonstration and Dissemination Policy and Importance of Renewable Energy

Objectives

Denmark undertakes a full range of energy R&D, from hydrocarbon research to support its oil and gas industry, energy conservation R&D and renewables. Research covers basic research through to commercialization.

As shown below, renewable energies represent a high percentage of total R&D (over 28 per cent) with most of that concentrated on wind energy.

Emphasis is being given to the development of large-scale wind turbines, the determination of wind resources, improvements in wind/diesel systems and extension of wind turbines for purposes other than generating electricity.

Bioenergy will concentrate on gasification of straw for CHP, monitoring and controlling large scale biogas plants and reduction of the logistical cost for handling straw from the field to the energy conversion plant.

Major Policy Instruments Used

The full range of policy instruments -- information, financial incentives, regulations and R&D -- are used. Of particular importance is a government negotiated requirement for utilities to develop 100 MW of wind turbine capacity by 1991 and a further 100 MW by 1994. The government has also banned straw from being burned in fields and instead provides incentives for it to be used in CHP plants. It also provides subsidies for investments in solar energy.

Level of Funding for R&D and Demonstration for Renewables

In 1989 the budget for renewable energy R&D and demonstration was US$9.37 million. This represented 28.1 per cent of total R&D and demonstration funding. The shares of funding amongst the various technologies were (%):

Solar	6.0
Wind	71.9
Biomass	17.7
Ocean	4.4

C Program Delivery

The R&D program is co-ordinated by the Danish Energy Agency, the main implementing body of the Ministry of Energy. Riso National Laboratory undertakes much of the research and is responsible for certification of wind turbines. There is a committee of outside experts which advises on priorities.

There is an independent agency which receives funding from the government, the Folkecenter for Renewable Energy which promotes "information dissemination and know-how" and develops "renewable energy techniques with a special view to production and employment within small and medium-scale industries."

D Major Policy and Related Documents Available

Danish Ministry of Energy, *Energy 2000, A Plan Of Action for Sustainable Development*, April 1990

Danish Ministry of Energy, *Wind Energy in Denmark, Research and Technological Development, 1990.*

4. FINLAND

A Introduction

Energy Demand and Role of Renewables

	TPER (mtoe)	% Renewables	Projected % in 2000
1986*	28.3	15.9	N.A.
1988**	29.6	16.7	N.A.

* Projection made for 1988 report, Renewable Energy Policies in Europe

** Latest projection

General Energy Policy and Relative Importance of Renewable Energy

Finland has few indigenous resources and thus security of supply has been an important element of energy policy. This is done through increasing the share of indigenous resources (peat, renewables) and energy conservation.

B Energy R&D, Demonstration and Dissemination Policy and Importance of Renewable Energy

Objectives

The goals for Finland's energy research program are:

- improve energy economy domestically;
- finding solutions to long-term threats and challenges;
- consolidation of national resources and raising the overall level of scientific research in these areas;
- training of research staff; and
- better co-operation internationally and increased technology transfer from abroad.

In 1988 the research program was re-organized with more emphasis being given to long-term basic research. The new five-year program began with ten program areas. The previous program had over 300 projects. The new program stresses: "how to more efficiently utilize energy in buildings and industry as well as to study various aspects of energy production, from fuel processing to electricity and heat production." Half the programs deal with renewables: Advanced energy systems and technologies, combustion technology, artificial dewatering of peat, fuel conversion, and peat production based on solar energy.

Major Policy Instruments Used

The government supports research and provides subsidies to industry and municipalities for investments which use indigenous resources (mainly renewables).

Level of Funding for R&D and Demonstration for Renewables

In 1989 the budget for renewable energy R&D and demonstration was US$ 8.1 million. This represented about 55 per cent of total R&D and demonstration funding. This includes funding for peat and combustion technology which is not only for renewable energy. Renewables given special attention are peat and biomass.

C Program Delivery

Energy research is financed by the Ministry of Trade and Industry. The Ministry provides about half of the total funds of the research projects. The rest comes from the other participants (industry, universities, institutes, etc).

Programs range from fundamental research to the application of innovative technologies but the new program gives more stress to basic research. The focus is on small and medium scale technologies relevant to local conditions.

Each program area has an executive committee represented by industry, research institutes, universities, government and other participants. There is a full-time director for each of the ten program areas

Information on the research projects is available in the Nordic Energy Index and the DOE Energy database.

D Major Policy and Related Documents Available

Government of Finland, *The Finnish Energy Policy Programme*, Helsinki, 1983
Ministry of Trade and Industry, *Finland's Energy Research Programmes*, 1989.

5. FRANCE

A Introduction

Energy Demand and Role of Renewables

	TPER (mtoe)	% Renewables	Projected % in 2000
1986*	200.8	1.99	3
1988**	208.9	4.6	3-4

* Projection made for 1988 report, Renewable Energy Policies in Europe
** Latest projection

General Energy Policy and Relative Importance of Renewable Energy

France gives a high priority to energy security by encouraging nuclear energy and energy conservation. Diversifying energy sources is very important in order to improve energy security and reduce fuel imports. Renewable energy is not a high priority but it does gain in status by being administered by the high profile Agence Française pour la Maîtrise de l'Énergie (A.F.M.E.) which is soon to be merged with two environment agencies.

In late 1990 the government came out with a White Paper on Environment which stresses environmental concerns throughout the entire energy cycle and gave higher priority to renewable energy.

In January 1991, a study commissioned by the government called "Énergie 2010" did not highlight renewable energy but did recommend a carbon tax, autoproduction of electricity, cogeneration and more hydropower.

After years of opposition, Électricité de France, the state-owned electricity utility, withdrew its opposition to autoproducers selling electricity to the grid.

B Energy R&D, Demonstration and Dissemination Policy and Importance of Renewable Energy

Objectives

The major focus for energy R&D is on nuclear and conventional fuels. However, there are four general categories of support:

- technologies that have impact today
- technologies in development which have special markets already
- technologies at stage of demonstrating technical/economic feasibility
- technologies at stage of research.

Major Policy Instruments Used

Research and development are important. Some subsidies are provided. The White Paper on Environment recommends financial incentives.

Level of Funding for R&D and Demonstration for Renewables

In 1989 the budget for renewable energy R&D and demonstration was US$5.97 million. The shares of funding amongst the various technologies were (%):

Solar, wind, small hydro	50.6
Biomass	28.1
Geothermal	21.3

C Program Delivery

The renewables R&D program is managed by the A.F.M.E. which has a laboratory in the south of France. The various renewable energy areas have experts committees to oversee the work and help set priorities. Funding is available from the Ministère de la Recherche and the Ministère de l'Industrie.

D Major Policy and Related Documents Available

Agence Francaise pour la Maîtrise de l'Énergie, *Rapport d'Activité*, 1987, 1988, 1989
Gouvernement de France, *Plan national pour l'environnement*, Juin 1990

6. GERMANY

A Introduction

Energy Demand and Role of Renewables

	TPER (mtoe)	% Renewables	Projected % in 2000
1986*	270.7	0.7	4-7
1988**	274.1	3	4

* Projection made for 1988 report, Renewable Energy Policies in Europe
** Latest projection

General Energy Policy and Relative Importance of Renewable Energy

Germany is currently trying to integrate the former East Germany into the economy. The east is very energy inefficient and polluted and will be a massive undertaking. Environmental issues have already been at the fore in Germany.

Energy security and financial support to its coal industry have been very important to Germany. It has a large nuclear industry although it is becoming exceeding difficult to expand it.

The government has established a target of 250 MW of installed capacity of wind turbines for utilities to meet. It is expected that this target will be increased to 500 MW. Total funding for the program is DM350 million (C$265 million).

B Energy R&D, Demonstration and Dissemination Policy and Importance of Renewable Energy

Objectives

The objectives of the German R&D program which was approved in 1989 are:

- further development of indigenous energy sources
- development of long-term, carbon dioxide-free energy sources, including renewables
- development of energy efficient technologies
- elaboration of strategies for sustained reduction of greenhouse gas emissions
- helping to ensure energy supply for growing world population without significant environmental impact.

There are five main subject areas for R&D: coal, renewables, energy conservation, nuclear and climate change.

Major Policy Instruments Used

There is a large R&D program. The government also provides financial credits for plants investing in renewable energy technologies. As of January 1, 1991 the government raised the minimum price for electricity produced from renewable energy sold to the grid to make renewables more competitive.

Level of Funding for R&D and Demonstration for Renewables

In 1989 the budget for renewable energy R&D and demonstration was US$93.24 million. This represented 18.9 per cent of total R&D and demonstration funding. The shares of funding amongst the various technologies were (%):

Solar	79.6
Wind	19.4
Biomass	0.1
Geothermal	1.0

For the entire program, there has been a big shift away from nuclear to renewables and clean coal technologies.

C Program Delivery

The research program is administered by the federal Ministry for Research and Technology (BMFT)

D Major Policy and Related Documents Available

None

7. GREECE

A Introduction

Energy Demand and Role of Renewables

	TPER (mtoe)	% Renewables	Projected % in 2000
1986*	18.3	2.5	3-5
1988**	20.5	6.1	10.0

* Projection made for 1988 report, Renewable Energy Policies in Europe
** Latest projection

General Energy Policy and Relative Importance of Renewables

The main objectives of the new general economic plan for 1988-1992 are:

-rational use of energy

-development of indigenous resources, and

-diversification of energy supply and modernization of equipment for energy supply.

B Energy R&D, Demonstration and Dissemination Policy and Importance of Renewable Energy

Objectives

There is a high priority given to renewable energy and energy energy efficiency. R&D programmes are funded separately from demonstration programmes. Being a small country, technology development efforts are primarily aimed at the demonstration, adaptation and application of developed technologies.

In 1989 a report was published by the Special Committee for the Development of Renewables and Conservation which gave proposals for Greece to renewables to reach 10 per cent of TPER by the year 2000.

Priorities

The highest priority is for development of renewable energy sources. Specific activities include:

- development and use of solar collectors;

- promotion of wind turbines;

- development of small-scale hydroelectric turbines;

- biomass applications, using agricultural and urban waste; and

- development of geothermal energy from both high and low enthalpy fields.

Major Policy Instruments Used

Some subsidies do exist for industrial and regional development.

Level of Funding for R&D and Demonstration for Renewables

In 1989 the budget for renewable energy R&D and demonstration was US$17.07 million. This represented 86.2 per cent of total R&D and demonstration funding. The shares of funding amongst the various technologies were (%):

Solar	13.7
Wind	45.3
Biomass	2.2
Ocean	0.4
Geothermal	38.4

C Program Delivery

The Ministry of Industry, Energy and Technology acts as the focal point for all domestic energy R&D and demonstration and for international collaboration. Greece now has the Centre for Renewable Energy Sources which is a centre of excellence in the subject and which supports the development of cheap and reliable renewable energy technologies. This Centre is partly funded by the European Community.

D Major Policy and Related Documents Available

IEA, *Technologies for Energy Efficiency and Fuel Switching: The Greek Approach Combining Efficiency and Renewable Energy Applications*, Paris, 1988.

8. IRELAND

A Introduction

Energy Demand and Role of Renewables

	TPER (mtoe)	% Renewables	Projected % in 2000
1986*	9.9	17.2	11
1988**	9.7	14.4	14

* Projection made for 1988 report, Renewable Energy Policies in Europe
** Latest projection

General Energy Policy and Relative Importance of Renewable Energy

Ireland's energy policy centres around reducing dependence on oil, largely through the use of indigenous peat and the introduction of natural gas, both indigenous and imported.

Renewable energy other than peat have traditionally not been given high priority. The recently published Environment Action Plan, however, encourages recycling municipal and industrial waste and conserving peat bogs.

B Energy R&D, Demonstration and Dissemination Policy and Importance of Renewable Energy

Objectives

There are several priority areas for R&D: renewable energy, emissions from open fireplaces, energy efficiency (electricity, transport and space heating). The government is currently evaluating proposals for a 5 MW wind farm.

Major Policy Instruments Used

The main policy instruments are R&D and demonstration.

Level of Funding for R&D and Demonstration for Renewables

In 1989 the budget for renewable energy R&D and demonstration was US$2.3 million. Approximately half the funds for RD&D come from the European Community and other international bodies.

C Program Delivery

The R&D program is co-ordinated by the Irish Science and Technology Agency, EOLAS, which also acts as the main conduit for obtaining funding from the EC. EOLAS is under the Department of Industry and Commerce.

State agencies such as ESB, the electric utility, and Bord na Mona, the producer of milled peat, also undertake research.

D Major Policy and Related Documents Available

Government of Ireland, *Environment Action Programme*, January 1990.

9. *ITALY*

A Introduction

Energy Demand and Role of Renewables

	TPER (mtoe)	% Renewables	Projected % in 2000
1986*	143.1	1.2	0.6
1988**	151.7	2.0	n.a.

* Projection made for 1988 report, Renewable Energy Policies in Europe
** Latest projection

General Energy Policy and Relative Importance of Renewable Energy

The National Energy Plan (PEN) was approved in 1988 and is currently being implemented. There are five main objectives: energy conservation, environmental protection, development of indigenous energy resources and diversification of energy import suppliers. There is also a five year moratorium on constructing new nuclear facilities.

In December 1990 the strategy for rational use of energy and renewable energy under the PEN was approved. It includes many incentives to encourage the commercialization of renewable energy technologies.

The growing environmental movement has made it difficult for ENEL, the state electric utility, to undertake any capacity expansion. Thus, energy conservation and to some extent renewables have become much more important.

B Energy R&D, Demonstration and Dissemination Policy and Importance of Renewable Energy

Objectives

PEN stresses non-nuclear fission R&D. Renewables is one of the priority areas along with nuclear fusion, conservation, coal and environmental protection.

For renewables, priority is given to geothermal, large wind turbines, photovoltaics and biomass. ENEL has several geothermal plants in use and many more are planned for the 1990s.

Major Policy Instruments Used

The new law for renewable energy and rational use of energy outlines several measures. There will be many more demonstration and information programs. Subsidies between 20 and 40 per cent will be available for improving energy use in buildings. This includes heat pumps and systems using renewable energy for heating or hot water heating which supply at least 30 per cent of needs. The

subsidies will be up to 80 per cent for photovoltaics. There are subsidies up to 50 per cent for feasibility and design studies for energy derived from cogeneration. There are also subsidies of 30 per cent for investments in renewable energies for cogeneration and further subsidies of 55 per cent for using renewable energy in agriculture.

Level of Funding for R&D and Demonstration for Renewables

In 1989 the budget for renewable energy R&D and demonstration was US$36.52 million. This represented 5.9 per cent of total R&D and demonstration funding. The shares of funding amongst the various technologies were (%):

Solar	38.2
Wind	46.0
Biomass	15.8

C Program Delivery

Energy R&D is co-ordinated by ENEA, the national committee for nuclear and alternative energies. It works closely with the Ministry of Industry.

D Major Policy and Related Documents Available

None

10. NETHERLANDS

A Introduction

Energy Demand and Role of Renewables

	TPER (mtoe)	% Renewables	Projected % in 2000
1986*	63.7	0.2	0.9
1988**	64.5	0.3	3.6

* Projection made for 1988 report, Renewable Energy Policies in Europe
** Latest projection

General Energy Policy and Relative Importance of Renewables

Since 1973 the primary goals for Dutch energy policy has continued to be:

- energy efficiency
- diversification of fuel supply; and
- exploitation and exploration of indigenous energy sources.

The Netherlands is a major producer and exporter of natural gas. Gas also has a higher share of TPER than in any other country in the world -- some 52 per cent. Gas also provides 60 per cent of the fuel input for electricity generation. It is an objective to diversify away from gas, particularly for electricity generation.

Expanding renewable energy has become an increasingly important element of Dutch energy policy. The government published its *Memorandum on Energy Conservation* in 1990 which gives strong emphasis to renewable energy. The government has set a target of 1000 MW of installed wind energy capacity and recently it reached an agreement with seven provinces to install 1000 MW of wind energy capacity by the year 2000.

B Energy R&D, Demonstration and Dissemination Policy and Importance of Renewable Energy

Objectives

Major emphasis is on a co-ordinated approach from research through to commercialization. The major objective is to direct R&D and demonstration towards contributions to the realization of its energy policy objectives. Secondary objectives include: contribution to innovation in Dutch industry, environment, health and safety.

Priorities

Priority criteria resulting from the energy objectives, used at the program planning level, include:

- importance in view of policy objectives
- markets for results
- availability of scientific, industrial infrastructure
- opportunities for international collaboration
- involvement of industry, and
- cost/benefit ratio.

In the year 2010 it is expected that the largest contributions will be made by wind energy, waste incineration and energy from biomass. The government believes the contribution from photovoltaics will be limited but they see it as a main source in the very long term.

Major Policy Instruments Used

The Netherlands uses the complete range of policy instruments from R&D and demonstration through to information, regulations, advice and financial incentives. These policy instruments are used in a co-ordinated manner to achieve policy goals in the most efficient way possible. An important instrument used is the setting of a fixed target for specified capacity installation by the year 2000.

There is the Stimulation Scheme for Wind Energy (IPW) which provided subsides for wind energy investments. Subsidies were available to manufacturers for up to 70 per cent of the cost of developing turbines with rotor blades longer than 12 metres. Subsidies are also available to purchasers of wind turbines. Under the conservation and renewable energy program announced in the Memorandum on Energy Conservation, subsidies will be given for solar-powered hot water appliances and solar cells.

Level of Funding for R&D and Demonstration for Renewables

In 1989 the budget for renewable energy R&D and demonstration was US$19.66 million. This represented 14.8 per cent of total R&D and demonstration funding. The shares of funding amongst the various technologies were (%):

Solar	32.8
Wind	31.9
Biomass	20.9
Ocean	4.8
Geothermal	9.6

Netherlands is currently going through a budget reduction process which could affect funds available.

The projected annual budget for the period 1990 to 1994 is:

Wind	44.5 million florins (C$29.8 million)
Photovoltaics	13.5 million florins (C$9.1 million)
Solar Thermal	12.0 million florins (C$8.0 million)
Geothermal	6.5 million florins (C$4.4 million)
Total	76.5 million florins (C$51.3 million).

This includes research and development (38.6 per cent of total), demonstrations (13.1 per cent) and subsidies (48.3 per cent).

C Program Delivery

The RD&D program is co-ordinated by NOVEM, the Netherlands Organization for Energy and Environment which co-ordinates the process from research through to marketing. The Netherlands

Energy Research Foundation undertakes much of the research. Its funding comes from NOVEM and the government directly.

D Major Policy and Related Documents Available

Krekel van der Woerd Wouterse, *Renewable Energy: Exploration of the Future*, July 1987
Ministry of Economic Affairs, *Memorandum on Energy Conservation: Strategy for Energy Conservation and Renewable Energy Resources*, June 1990

11. NORWAY

A Introduction

Energy Demand and Role of Renewables

	TPER (mtoe)	% Renewables	Projected % in 2000
1986*	28.0	3.0	3.0
1988**	28.0	3.3	3.0

* Projection made for 1988 report, Renewable Energy Policies in Europe
** Latest projection

General Energy Policy and Relative Importance of Renewables

Norway is a major oil and gas producer and, given its size and population, energy development represents the highest share of GDP in the IEA. The major element of energy policy is the steady development of the petroleum sector.

The government is giving high priority to environmental objectives and has introduced a law to increase competition in the electricity sector. Both priorities should expand the use of renewables.

B Energy R&D, Demonstration and Dissemination Policy and Importance of Renewables

Objectives

The major objectives of R&D and demonstration policy are to:

- enhancing the added value from Norwegian petroleum activities, including increased production from petroleum products, both in general and from each field, within socio-economically justifiable limits;

- increasing the energy supply through better utilization of existing sources of energy, and in the longer term, by developing new sources of energy;

- realizing the greatest possible amount of the energy-saving potential within the different sectors;

- making production and use of energy occur with minimal effects upon nature and the environment; and

- making conditions favourable for competitive Norwegian industrial production and other business and trade activities within the energy sector.

Recently, higher priority has been given to research into renewable energies, particularly to biomass, wave power and solar energy.

Major Policy Instruments Used

The main instrument is funding for research and development. As of January 1, 1991 the government has deregulated the electricity industry which may make it easier for autoproducers to sell electricity to the grid.

Level of Funding for R&D and Demonstration for Renewables

In 1989 the budget for renewable energy R&D and demonstration was US$7.87 million. This represented 17.3 per cent of total R&D and demonstration funding. The shares of funding amongst the various technologies were (%):

Solar	9.5
Wind	12.7
Biomass	18.4
Ocean	7.4
Geothermal	52.0

C Program Delivery

The Ministry of Petroleum and Industry is responsible for energy R&D.

D Major Policy and Related Documents Available

None

12. PORTUGAL

A Introduction

Energy Demand and Role of Renewables

	TPER (mtoe)	% Renewables	Projected % in 2000
1986*	13.6	6.7	4.8
1988**	15.7	7.3	6.3

* Projection made for 1988 report, Renewable Energy Policies in Europe
** Latest projection

General Energy Policy and Relative Importance of Renewable Energy

Portugal has few indigenous energy resources and thus development of renewable energy and energy efficiency are considered to be important elements of energy policy. The main policy objectives are to encourage a more flexible energy supply system and to open the energy sector to more competition and private investment. Emphasis is now being given to introducing natural gas. Mini-hydro projects are being encouraged primarily through EC funding.

There have been over 800 applications to build small hydro plants (less than 10 MW). It is believed that about one-third will be chose, adding about 1 to 2 GW of capacity.

B Energy R&D, Demonstration and Dissemination Policy and Importance of Renewables

Objectives

The main objectives are to "diversify available energy sources and to introduce new, economic, and energy-efficient technologies."[1] The technology priorities are:

- energy efficiency
- decentralized energy production
- development of new processes.

Small-scale hydro and biomass are the two priority areas for renewables because of the potential future contribution. These were chosen after government analysis. There is only one small-scale hydro project at the Technical University of Lisbon. Most of the activity is with biomass because of

[1] IEA, *Energy Policies and Programmes of IEA Countries*, Paris, 1990, p. 524.

the high potential. It is estimated that there are 3.54 Mt of green wastes of which only 0.068 Mt are used for energy production and 2.46 Mt of industrial forest wastes of which only 0.222 Mt are used.

The government has established a Biomass Centre which is involved in combustion technologies.

Major Policy Instruments Used

Funding is available from the government and from the European Community.

Level of Funding for R&D and Demonstration for Renewables

In 1989 the budget for renewable energy R&D and demonstration was US$2.19 million. This represented 31.1 per cent of total R&D and demonstration funding. The shares of funding amongst the various technologies were (%):

Solar	50.7
Wind	8.7
Biomass	31.1
Ocean	6.4
Geothermal	3.2

C Program Delivery

The Ministry of Industry and Energy is responsible for energy R&D planning. This is co-ordinated with the Ministry of Planning. LNETI, the National Laboratory of Engineering and Industrial Technology, undertakes most of the R&D activity.

D Major Policy and Related Documents Available

None

13. SPAIN

A Introduction

Energy Demand and Role of Renewables

	TPER (mtoe)	% Renewables	Projected % in 2000
1986*	75.9	0.2	2.6
1988**	84.6	3.0	2 - 3

* Projection made for 1988 report, Renewable Energy Policies in Europe
** Latest projection

In 1988, of total supply from renewables, the shares were (%):

biomass	83.2
mini-hydro	15.2
solar	1.5
geothermal	0.1
wind	0.1

General Energy Policy and Relative Importance of Renewable Energy

The government has prepared a new National Energy Plan (NEP) but it has been delayed going to Parliament because of the Gulf war. It will probably be tabled in the fall session of Parliament. The three objectives of the previous NEP are still valid: rational use of energy, reduce imports and bring capacity in line with demand projections.

The most recent National Plan for Renewable Energies (PER) was approved in 1989, covering the period to 1995. It is an action plan to substantially increase the share of renewable energy in total energy demand. It also encourages Spanish industry to compete domestically and abroad.

The PER has been very successful in encouraging investments in renewables. It has recently been reported that a total of C$ 933 million were invested in 1990 in renewable energy technologies. For a program that is going to 1995, over half of government funds allocated to the program were distributed in the first year.

B Energy R&D, Demonstration and Dissemination Policy and Importance of Renewable Energy

Objectives

The current Energy Research Plan was also approved in 1989 and covers the period 1989 to 1992. The priority areas are: energy efficiency, advanced coal technologies, environment, nuclear energy and renewables.

Priority areas for renewables include: solar (passive, low and high temperature, photovoltaics, solar cells), wind (1.2 MW generator and 75 to 250 kW generators), biomass (biotechnology, etc).

Major Policy Instruments Used

The PER provides for subsidies for investments in renewable energy. For the period 1989 to 1995, the budget allocated is 35,514 million pesatas (C$ 433 million) for a total investment of 146,440 million pesatas (C$ 1.786 billion).

The Renewable Energy Institute also has a comprehensive information program with publications, workshops and training.

Level of Funding for R&D and Demonstration for Renewables

In 1989 the budget for renewable energy R&D and demonstration was $6.87 million. This represented 13.3 per cent of total R&D and demonstration funding. The shares of funding amongst the various technologies were (%):

Solar	29.5
Wind	7.9
Biomass	51.1
Geothermal	11.5

C Program Delivery

The Instituto de Energias Renovables of the Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas (CIEMAT) under the Ministerio de Industria y Energia carries out most of the renewable R&D. Policy analysis is done by the Ministry.

The Instituto de Desarollo e Ahorro de Energia (IDAE) manages the PER program providing financial incentives.

D Major Policy and Related Documents Available

Ministerio de Industria y Energia, *Plan de Energias Renovables (PER-89)*, Madrid, 1989
Instituto de Energias Renovables, *Memoria Anual*, 1989

14. SWEDEN

A Introduction

Energy Demand and Role of Renewables

	TPER (mtoe)	% Renewables	Projected % in 2000
1986*	55.3	4.9	7.3
1988**	56.2	11	10 - 11

* Projection made for 1988 report, Renewable Energy Policies in Europe
** Latest projection

General Energy Policy and Relative Importance of Renewables

The stated objectives of Swedish energy policy are to:

- conserve and make efficient use of energy;

- reduce the use of oil;

- increase use of primarily indigenous and renewable energy sources; and

- phase out nuclear power by the year 2010.

Sweden is not well endowed with energy sources. It is highly dependent on imported energy, particularly oil. The major objective which is now affecting general energy policy is the phase out of nuclear power by 2010. The first two plants were planned to be phased out in the mid-1990s but an all-party agreement has postponed the phase-out. The phase-out now depends on progress in energy saving, renewable energy and maintaining international competitiveness.

Sweden stresses the importance of renewables through energy policy objectives but more importantly through comprehensive program initiatives.

B Energy R&D, Demonstration and Dissemination Policy and Importance of Renewables

Objectives

The current three-year R&D program came into force in 1990. The emphasis is on contending with the nuclear phase-out: developing environmentally acceptable, renewable and indigenous energy sources and to increase the efficiency of energy use. More emphasis is now given to fundamental research because it is felt that the earlier program was too geared to technology development before understanding some of the basic principles.

Vattenfall, the Swedish State Power Board and the country's largest utility, also has a large renewable energy R&D program (representing over 15 per cent of total utility R&D). It is now giving emphasis to bioenergy, particularly for bio fuel production and marketing, technology for electric power generation and cogeneration, and system studies. Their belief is that they "need to acquire knowledge of the entire chain in a biofuel-based system for the production of heat and power.

Major Policy Instruments Used

The main instruments are R&D and Demonstration. There is also tax relief and investment grants for cogeneration plants, many of which are to be fueled by renewable energies. There are also grants for small-scale wind power units and solar heating plants. There is also a Fund for Energy Technologies which provides funding for studies, lab scale tests, pilot plants, and full scale demonstration plants where no funding is available. The Fund never provides more than 50 per cent to a project.

Level of Funding for R&D and Demonstration for Renewables

In 1989 the budget for renewable energy R&D and demonstration was US$19.31 million. This represented 21.3 per cent of total R&D and demonstration funding. The shares of funding amongst the various technologies were (%):

Solar	34.4
Wind	30.9
Biomass	33.2
Geothermal	1.6

C Program Delivery

Energy policy and programs have recently been shifted from the former Ministry of Energy and Environment to the Ministry of Industry. The Energy Research Council which helped establish technology priorities and undertook evaluations has been merged with the National Energy Administration (NEA), of the main bodies under the Ministry doing policy analysis and implementing programs. It was announced in February 1991 that the NEA is to be abolished as of July 1st. It is to be merged with other agencies to form a new industrial administration.

As seen above, Vattenfall also has a large R&D program.

D Major Policy and Related Documents Available

None

15. SWITZERLAND

A Introduction

Energy Demand and Role of Renewables

	TPER (mtoe)	% Renewables	Projected % in 2000
1986*	28.0	1.0	2.8
1988**	28.2	3.5	4.4

* Projection made for 1988 report, Renewable Energy Policies in Europe
** Latest projection

General Energy Policy and Relative Importance of Renewable Energy

In the past few years, environmental concerns have had a strong impact on energy policy: concerns over the widespread damage to the forests and the nuclear debate, renewed by the nuclear accident

in Chernobyl. To contend with the damage to the forests, comprehensive energy efficiency initiatives have been planned through co-ordination between the two levels of government.

In 1990 there were several referenda on energy. One put a moratorium of ten years on the construction of new nuclear energy facilities. Another gave the federal government more authority over energy policy.

The government announced "Energy 2000" in September 1990 to support energy conservation and renewable energy. The program which was presented to Parliament in February is being defined in 1991 and will combine both federal and cantonal measures, primarily for demonstrations, dissemination and information.

B Energy R&D, Demonstration and Dissemination Policy and Importance of Renewable Energy

Objectives

The objectives adopted in 1984 still remain:

- strong support for energy efficiency, renewable energy and energy-related processes
- back-up of prospecting for indigenous resources and maintaining support for nuclear R&D.

The current R&D program was approved in 1987 and covers 1988 to 1992. The government is currently preparing the plan for 1992 to 1995.

The government is trying to stimulate joint government/industry projects and putting more emphasis on technology transfer. Federal programs mainly supported basic, and to a limited extent, applied research. Pilot and demonstration activities are left to the private sector. The confederation government is trying to extend its authority in order to undertake demonstrations as a critical link to commercializing technologies.

High priority is given to solar energy, particularly photovoltaics.

Major Policy Instruments Used

Financial incentives are available for renewable energy and waste utilization. Many cantons also provide incentives.

Level of Funding for R&D and Demonstration for Renewables

In 1989 the budget for renewable energy R&D and demonstration was US$18.28 million. This represented 18.1 per cent of total R&D and demonstration funding. The shares of funding amongst the various technologies were (%):

Solar	65.9
Wind	2.4
Biomass	12.7
Geothermal	19.1

C Program Delivery

The R&D program is managed by the Federal Office for Energy.

D Major Policy and Related Documents Available

None

16. UNITED KINGDOM

A Introduction

Energy Demand and Role of Renewables

	TPER (mtoe)	% Renewables	Projected % in 2000
1986*	205.9	0	2.3
1988**	208.5	0	3-4***

* Projection made for 1988 report, Renewable Energy Policies in Europe
** Latest projection
*** For electricity generation

General Energy Policy and Relative Importance of Renewable Energy

The broad goal of the government is to ensure adequate and secure energy supplies at the lowest, long-term cost. It benefits from abundant supplies of oil, gas and coal. The approach taken by the government is one which is very market-oriented.

Recently, renewable energy has become more important in energy policy for two reasons. The terms of the privatization of the electricity industry requires a certain non-fossil fuel obligation (NFFO). This initially means requiring the regional utilities to supply a specified amount of nuclear energy but there will be further requirements to encourage renewable energy. In 1990, 75 projects

were proposed. These included scrap tires, landfill gas, biogas, waste incineration and wind projects. A 20 MW energy-from-tires plant was approved in October 1990. The first tranche of renewable energy projects represented about 170 MW of capacity. Proposals for a second tranche have been requested. This will be about another 200 MW. Altogether it is expected that when the NFFO expires in 1998 that about 600 MW of renewable energy capacity will be deployed.

The NFFO expires in 1998 under a negotiated agreement with the European Commission. Many sponsors for renewable projects, however, had been expecting a longer period for subsidies and thus many projects have been scrapped. The wind turbine industry has been particularly affected. Once privatization of the electricity industry is complete, the government may go back to the Commission to request an extension for renewables beyond 1998.

The 1990 white paper on environment announced a target of 1000 MW of renewable energy power capacity by the year 2000. Plans are currently underway on how to achieve that target and they should be published in early 1992.

B Energy R&D, Demonstration and Dissemination Policy and Importance of Renewables

Objectives

There are four main objectives to the UK's research program:

- support necessary work that would not otherwise be undertaken
- encourage private sector activity
- ensure effective dissemination of R&D and demonstration results
- manage R&D economically and effectively, including national and international collaborative arrangements where appropriate.

The program has two aims for renewables:

-encourage and promote the commercialization of "economically attractive" technologies
-reduce uncertainties about economics and potential contribution of those technologies currently classified as "promising but uncertain."

The government published a study in 1988 (Energy Paper 55, *The Way Forward* -- see last section) which provides three classifications for technologies: economically attractive, promising but uncertain and long shots. They curtailed work on the "long shots." They are currently revising that study to assess how they can best achieve the target of 1000 MW.

The latest tranche for proposals for the NFFO specifies bands for the different renewable energies so they will not compete with each other: waste incineration 50-100 MW; landfill gas 30-60 MW; wind power 25-50 MW; hydro 5-10 MW and others 15-30 MW.

Major Policy Instruments Used

The Department of Energy funds about 250 projects a year. These are partly funded by private industry and the European Community. One of the most powerful instruments right now is the NFFO. The two national utilities, Powergen and National Power, which were formed after the break

up of the Central Electricity Generation Board during the privatization process are not required to produce electricity from renewables.

Level of Funding for R&D and Demonstration for Renewable Energy

In 1989 the budget for renewable energy R&D and demonstration was US$23.65 million. This represented 7.1 per cent of total R&D and demonstration funding. The shares of funding amongst the various technologies were (%):

Solar	13.2
Wind	37.8
Biomass	19.6
Ocean	8.3
Geothermal	21.1

The funding for R&D will be increasing by 20 per cent in nominal terms between 1990 and 1991 and then will remain at that level for four years. Funds will in particular go up for biofuels and tidal.

C Program Delivery

The overall strategy is co-ordinated by the Energy Technology Division in the Department of Energy and managed by the Energy Technology Support Unit (ETSU) at the Atomic Energy Authority in Harwell. The program also stresses international collaboration through the IEA and funding from the European Community. The UK also has bilateral programs with US, USSR and Greece. They exchange information with Oak Ridge National Laboratories. They have had bilateral workshops on waste combustion, biofuels and passive solar.

D Major Policy and Related Documents Available

Department of Energy, *Renewable Energy in the UK: The Way Forward*, Energy Paper Number 55, 1988

Department of Environment, *This Common Inheritance: Britain's Environmental Strategy*, London, 1990

ETSU, *Prospects for Renewable Energy in the NORWEB Area*, 1989.

Annex 2

Programs Available from the Commission of the European Communities to Encourage Renewable Energy Technologies

The Commission of the European Communities (CEC) has a number of programs to encourage the development and commercialization of renewable energy technologies. It is also planning new programs and studies. The following is a brief review of the main areas of activity:

• *R&D*

The 1990-1994 Framework Program for R&D shows 814 million ECU (C$1.26 billion) allocated for energy R&D. This represents 14 per cent of total R&D funding. Non-nuclear energies (analyses and modelling, improved use of fossil fuels, renewable energies and rational use of energy) will receive 157 million ECU (C$243.9 million) which represents 19 per cent of the total R&D program. Safety of nuclear fission will receive 25 per cent and controlled nuclear fission will receive 56 per cent. One per cent of the 157 million ECU is for dissemination of results.

A large part of the biomass component has been taken out of the 1990-1994 program and is included in the agriculture R&D program. However, energy from biomass is included in the non-nuclear energies program. Renewable energy R&D is expected to take 30-40 per cent of the non-nuclear energies budget.

The previous program which is still underway is called **JOULE**. The previous program allocated 122 million ECU (C$189.5 million) for 1989-1992 which overlaps the 1990-1994 Framework Program.

• *THERMIE*

Thermie is the "Program for the Promotion of Energy Technology for Europe". The objective of the program is to "share a proportion of the financial risks involved in promoting and disseminating innovative technologies" in the areas of rational use of energy, new and renewable sources of energy, solid fuels and hydrocarbons.

There is no specific breakdown for technology areas but renewable energy technologies will receive "heavy emphasis."

The program is to last five years and funding for the first three years will be 350 million ECU (C$543.8 million). The Community will contribute up to 35 per cent of the costs of dissemination projects and 40 per cent of the costs of innovative projects.

The program is spending 20 million ECU (C$31.1 million) per year to promote the technologies through various means. The most important is a network of 33 information centres (Opets -- Offices for the Promotion of Energy Technologies). These offices range from existing government agencies (such as the A.F.M.E. in France) to consulting firms. Twenty-eight of the 33 Opets promote renewable energy technologies.

Thermie is also dedicating an unspecified amount for technology transfer to Eastern Europe and the Soviet Union.

• VALOREN

The VALOREN program is a regional program to help disadvantaged areas by improving their supply of energy at the local level. This is accomplished by: using local energy resources (renewables, local peat and brown coal), rational use of energy in small and medium enterprises and the promotion and better use of the energy potential at the local and regional levels. Loans and grants are made available to local and regional governments.

• EUREKA

Eureka was formed in 1985 by 19 European countries and the Commission of the EC to develop innovative technologies including renewable energy technologies. The focus is on market-based research. Currently there are approximately 300 projects valued at 6.4 billion ECU (C$9.94 billion). More than 1600 firms and research institutes participate. Research Ministers from the 19 countries met earlier in June this year to approve new projects. Of the 91 chosen, 37 were in the field of the environment (valued at 253 million ECU or C$393 million) and 2 in the field of energy (27 million ECU or C$42 million).

• SESAME

SESAME is an on-line source of information on energy projects supported by the Community. It contains information on energy saving, renewable sources of energy, liquefaction and gasification, new use of solid fuels, electricity, heat and hydrocarbon technology. Access is also granted to non-Member countries.

Information can be obtained by contacting DG XVII directly at 200, rue de la Loi, 1049 Brussels (fax 32-2) 235 01 50.

• PHARE

This program is designed to provide assistance for economic restructuring in central and eastern Europe and is part of a 300 million ECU (C$466 million) aid program. Priority areas include agriculture, investment, the environment and training. PHARE initially gave assistance to Poland and Hungary but the program has now been extended to include Bulgaria, Czechoslovakia and Yugoslavia. The environment and special environmental protection programs have been set up for both Poland and Hungary. Initial priority is being given to improving their environmental monitoring capacity. Longer-term actions will include industrial pollutants, nuclear safety, waste water treatment, and and water pollution monitoring equipment, elimination of toxic waste, training of local specialists and management.

PHARE is now used to fund more and more projects including energy.

All 24 members of the OECD participate in PHARE.

• Study on Renewable Energy Potential

The Commission will soon start a one and one-half year study on the potential for renewable energy in Europe (including Eastern Europe). The study will not only look at the technical potential but will analyze the barriers to the penetration of renewables. The study will cost 500,000 ECU (approximately C$750,000).

• Study of National Regulations and Requirements for Installing Renewable Energy Technologies

The commission is currently compiling all the regulations and requirements for installing renewable energy technologies. This will be published when completed. No date is given but it is expected this year.

• ALTENER

ALTENER is a proposed new program to promote renewable energies. The program is expected to increase co-operation between the CEC and Member states and to develop new directives as needed. It is expected to combine financial, legislative, training and information. ALTENER was to have been approved in 1991 but it will not be presented to the Commission for approval until 1992, after its sister-program on energy conservation, SAVE, is approved and running.

• Publications and Conferences

The CEC publishes many reports on renewable energy and sponsors many conferences.

Annex 3

Acronyms

CEC	Commission of the European Communities which is the executive of the European Community. It comprises 17 Commissioners and the Services which are made up of 23 directorates-general.
CHP	Combined heat and power, otherwise known as cogeneration
DGXII	The Directorate-General for Research in the CEC. It is responsible for energy research.
DGXVII	The Directorate-General for Energy in the CEC. It is responsible for energy policy and energy demonstrations.
EC	European Community which includes Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, United Kingdom. The Commission is based in Brussels, Belgium
GDP	Gross Domestic Product
IEA	International Energy Agency based in Paris, France.
kWh	kilowatt-hour
Mtoe	Million tonnes of oil equivalent
MW	Megawatt
NFFO	Non-Fossil-Fuel Obligation in the United Kingdom
OECD	Organization for Economic Co-operation and Development based in Paris, France
TFC	Total Final Consumption
TPER	Total Primary Energy Requirements